National Aeronautics and Space Administration

Fiscal Year 2010

PERFORMANCE AND ACCOUNTABILITY REPORT

www.nasa.gov

NASA's Performance and Accountability Report

The National Aeronautics and Space Administration (NASA) produces an annual Performance and Accountability Report (PAR) to share the Agency's progress toward achieving its Strategic Goals with the American people. In addition to performance information, the PAR also presents the Agency's financial statements as well as NASA's management challenges and the plans and efforts to overcome them.

NASA's Fiscal Year (FY) 2010 PAR satisfies many U.S. government reporting requirements including the Government Performance and Results Act of 1993, the Chief Financial Officers Act of 1990, and the Federal Financial Management Improvement Act of 1996.

NASA's FY 2010 PAR contains the following sections:

Management's Discussion and Analysis

The Management's Discussion and Analysis (MD&A) section highlights NASA's overall performance; including programmatic, financial, and management activities. The MD&A includes a description of NASA's organizational structure and describes the Agency's performance management system and management controls (i.e., values, policies, and procedures) that help program and financial managers achieve results and safeguard the integrity of NASA's programs.

Detailed Performance

The Detailed Performance section provides more in-depth information on NASA's progress toward achieving milestones and goals as defined in the Agency's Strategic Plan and NASA's FY 2010 Performance Plan Update. It also includes plans for correcting performance measures that NASA did not achieve in FY 2010 and an update on the measures that NASA did not complete in FY 2009.

Financials

The Financials section includes the Agency's financial statements, the audit results submitted by independent accountants in accordance with government auditing standards, and Agency responses to the audit findings.

Other Accompanying Information

The Other Accompanying Information (OAI) section includes the Inspector General's statement on NASA's management and performance challenges, the status of the Agency's follow-up actions on the Inspector General's audits, an Improper Payments Information Act assessment, a summary of the financial statement audit and management assurances, and NASA's Missions at a Glance, which provides more details about NASA flight missions mentioned in the PAR.

NASA's PAR is produced by the Office of the Chief Financial Officer's Strategic Investments Division, with contract support by The Tauri Group. If you have questions about NASA's PAR, please email *hq-dl-parteam@mail.nasa.gov*.

This document is available online at *http://www.nasa.gov/news/budget/index.html*.

Cover: On September 7, 2010, the International Space Station Expedition 24 crew took this photo of high-oblique view of the Gaspe Peninsula and Anticosti Island with sun glint on the Gulf of St. Lawrence and Chaleur Bay, Canada. (Credit: NASA)

Message from the Administrator

November 15, 2010

I am pleased to present NASA's FY 2010 Performance and Accountability Report (PAR). This report documents NASA's progress toward achieving the challenging mission of space exploration, scientific discovery, and aeronautics research as outlined in our Strategic Plan. Further, the performance and financial information presented in this report highlights our efforts to manage taxpayer dollars responsibly, while adhering to NASA's core values of Safety, Integrity, Teamwork, and Excellence.

We are proud of all of our accomplishments this year, and specific information is highlighted and discussed in the *Detailed Performance* Section of this report. However, I would like to mention a few of our specific accomplishments. We had four successful Space Shuttle launches to the International Space Station (ISS) since last November, to complete its construction and outfit it as a scientific facility like no other. The 10th anniversary of humans aboard the station was a true milestone, and we're entering an era where it will reach its true potential as an orbiting laboratory. Likewise, we were pleased to recognize the 20th anniversary of the launching of the Hubble Space Telescope and to begin seeing new results from the instruments with which it was outfitted on last year's servicing mission. This year, we also marked the 50th anniversary of weather observations from space—a year in which our Earth-observing satellites were also helpful in assessing the status on the ground after disasters such as the Haiti earthquake and the Gulf oil spill. Most recently, a NASA team assisted the Chilean government, through the U. S. Department of State, to provide technical advice that assisted the trapped miners at the San Jose gold and copper mine.

NASA launched the following science missions: Widefield Infrared Survey Explorer (WISE); Solar Dynamics Observatory (SDO); and Geostationary Operational Environmental Satellite (GOES). WISE will scan the entire sky to uncover objects never seen before, helping to answer fundamental questions about the origins of planets, stars, and galaxies. SDO began sending back amazing images of the sun that will help us understand our neighbor and its effects on our planet and our communications systems. In September 2010, the latest Geostationary Operational Environmental Satellite, GOES-15 (also known as GOES-P), was accepted into service. It is designed to watch for storm development and weather conditions on Earth, relay communications, provide search-and-rescue support, and also provide additional capacity for our Nations' weather observing system.

Exploration Systems successfully tested the Ares 1-X for a two-minute powered flight. Results from this test will be helpful in developing the next generation of American spaceflight vehicles that could take humans beyond low-Earth orbit. Our Lunar Reconnaissance Orbiter helped us map the Moon and transform our understanding of it. Aeronautics completed the first phase of the X48-B Low Speed Flight Test Program of a Hybrid wing body aircraft, which is intended to reduce environmental impacts associated with aviation. NASA engineers and scientists tested new rocket motors, moved forward on aviation technologies to make air travel safer and cleaner, and worked with students around the country to help widen the pipeline of future leaders.

In June 2010, NASA launched its Summer of Innovation program, in support of the President's Educate to Innovate campaign for excellence in science, technology, engineering, and mathematics (STEM) education. Our first round of activities gave students in Wyoming, Idaho, Massachusetts, and New Mexico hands-on experience with space missions and science experiments. In FY 2011, we will continue to expand this important work to help develop students' interest in the core STEM disciplines. In addition, NASA awarded cooperative agreements to organizations across the United States to enhance learning through the use of NASA's Earth Science resources. The selected organizations include colleges and universities, nonprofit groups, and community college representatives.

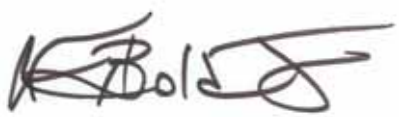
As Administrator, one of my key responsibilities defined in the Space Act of 1958 (as amended) is to "provide for the widest practicable and appropriate dissemination of information concerning (NASA's) activities and the results thereof." As such, NASA embraces the White House's Open Government initiative calling on executive branch agencies to become more open and accountable. From making our open source software development more collaborative to creating a cloud computing platform, or making our social networks easily accessible and conducive to interaction, NASA is taking many steps to implement this openness in all of its activities. Also worthy of note is NASA's successful initiative to fund, track, and report on its accomplishment toward the goals and objectives of the American Recovery and Reinvestment Act (Recovery Act). NASA received $1,050 million of Recovery Act funding in fiscal year 2009 ($1,002 million Direct Appropriation and $48 million Reimbursable Authority), all of which has been obligated on projects to support the Nation's economic recovery and advance NASA's research mission. The Agency received an additional $4 million in Recovery Act Reimbursable Authority in FY 2010.

Although NASA was unable to achieve the Agency's Strategic Goal to retire the Space Shuttle by the end of FY 2010, the Agency plans to retire the Space Shuttle within the next year. Despite a year of transition and uncertainty, on September 29, 2010, the United States Congress voted resoundingly to endorse a clear path forward for NASA. Drawing on the ambitious plan for our Agency laid out by President Barack Obama, the Congress approved the National Aeronautics and Space Administration Authorization Act of 2010, which was signed by the President on October 11, 2010. This Act helps put the U.S. space program on a more sustainable trajectory that will lead to greater technological capabilities for our Nation, a new commercial space transportation industry, deeper international partnerships, and missions that will help inspire a new generation of Americans. With this new direction, we will also extend the life of the ISS, expand our investments in green aviation, Earth observation and education, and work to create thousands of new jobs in a vibrant, forward-looking economy.

NASA makes every effort to ensure that performance data are subject to the same attention to detail as is devoted to our scientific and technical research. With this in mind, I can provide reasonable assurance that the performance data in this report are reliable and complete. Any data limitations are documented explicitly in the report.

In addition, NASA accepts the responsibility of accounting for and reporting on its financial activities. During FY 2010, NASA resolved the one remaining prior year internal control material weakness. The successful resolution of the prior year material weakness—Controls over Legacy Property, Plant, and Equipment related to valuation of legacy assets—is a result of extensive management involvement across the Agency. This achievement resulted from a sound system of financial controls and adherence to our Comprehensive Compliance Strategy and our Continuous Monitoring Program. In addition, we are now in compliance with the Federal Financial Management Improvement Act. Based on the results of this year's efforts, I am able to provide reasonable assurance that this report's financial data are reliable and complete.

My goal and focus, as NASA Administrator, is to continue to foster NASA as an exceptional resource for this Nation while keeping a sharp eye on our core values. We must always strive to find innovative ways to use NASA's missions to enhance our Nation's educational, scientific, and technological capacity.



Charles F. Bolden, Jr.
Administrator

Table of Contents

Credit: NASA

A team of NASA- and National Science Foundation-sponsored researchers announced the discovery of a planet three times the mass of Earth orbiting a nearby star. Named GJ 581g, this discovery was the result of more than a decade of observations using the W. M. Keck Observatory in Hawaii, one of the world's largest optical telescopes. The researchers believe the planet is in an area where liquid water could possibly exist on the planet's surface. If confirmed, this new planet would be the most Earth-like planet discovered beyond the solar system.

The above artist's concept shows the inner four planets of the Gliese 581 system and their host star, a red dwarf star, only 20 light years away from Earth. The large planet in the foreground is the newly discovered GJ 581g.

For more on this story go to *http://www.nasa.gov/topics/universe/features/gliese_581_feature.html*.

Management's Discussion and Analysis

Welcome to NASA

NASA's Mission

National Aeronautics and Space Administration (NASA) was created by the National Aeronautics and Space Act of 1958. The Agency was created to provide for research into problems of flight within and outside the Earth's atmosphere and to ensure that the United States conducts activities in space devoted to peaceful purposes for the benefit of mankind.

NASA's Mission Statement

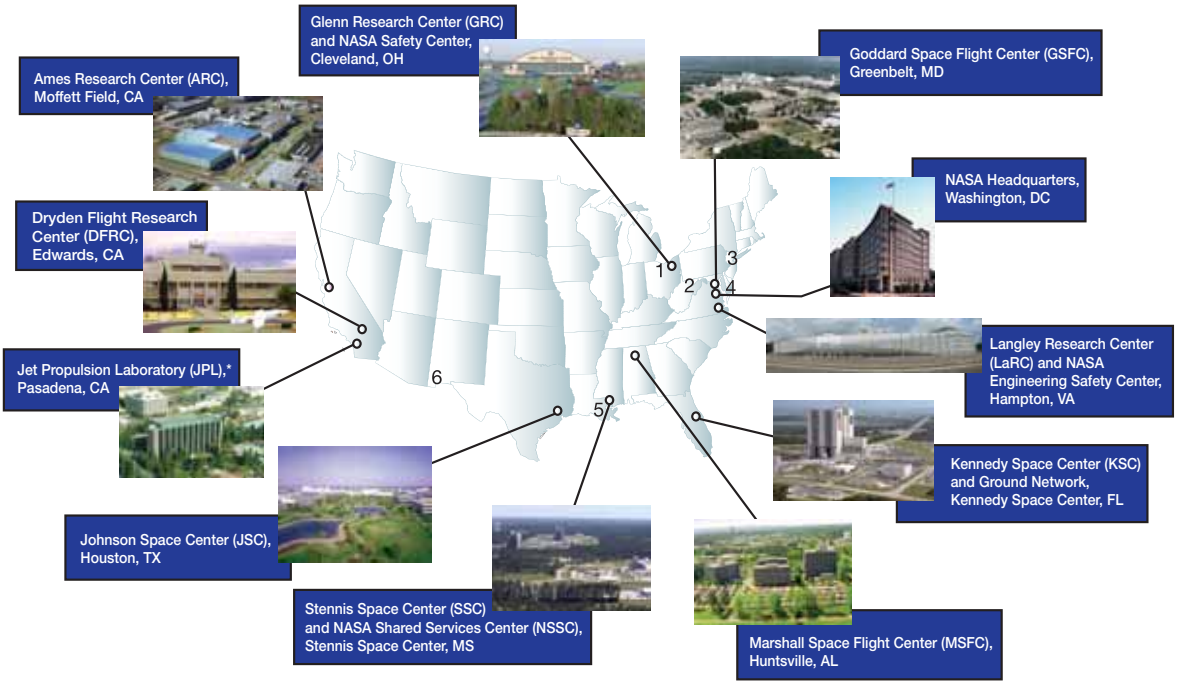
To pioneer the future in space exploration, scientific discovery, and aeronautics research.

NASA's Organization

NASA is comprised of Headquarters in Washington, DC, nine Centers located around the country, and the Jet Propulsion Laboratory, a Federally Funded Research and Development Center (FFRDC) operated under a contract with the California Institute of Technology. In addition, NASA partners with academia, the private sector, state and local governments, other Federal agencies, and a number of international organizations, to create an extended NASA family of civil servants, contractors, allied partners, and stakeholders.

Photo above: NASA astronaut Clayton Anderson, STS-131 mission specialist, participates in the mission's first session of space-walks on April 9, 2010, as construction and maintenance continue on the International Space Station. Reflected in his helmet is Rick Mastracchio, mission specialist, who helped him move a new 1,700-pound ammonia tank from Space Shuttle *Discovery*'s cargo bay to a temporary parking place on the station, retrieve an experiment from the Japanese Kibo Laboratory exposed facility, and replace a Rate Gyro Assembly on one of the truss segments. (Credit: NASA)

NASA Centers and Other Facilities



*The Jet Propulsion Laboratory is a FFRDC, NASA-owned and managed under the terms of a contract with the California Institute of Technology. The workforce are employees of the California Institute of Technology.

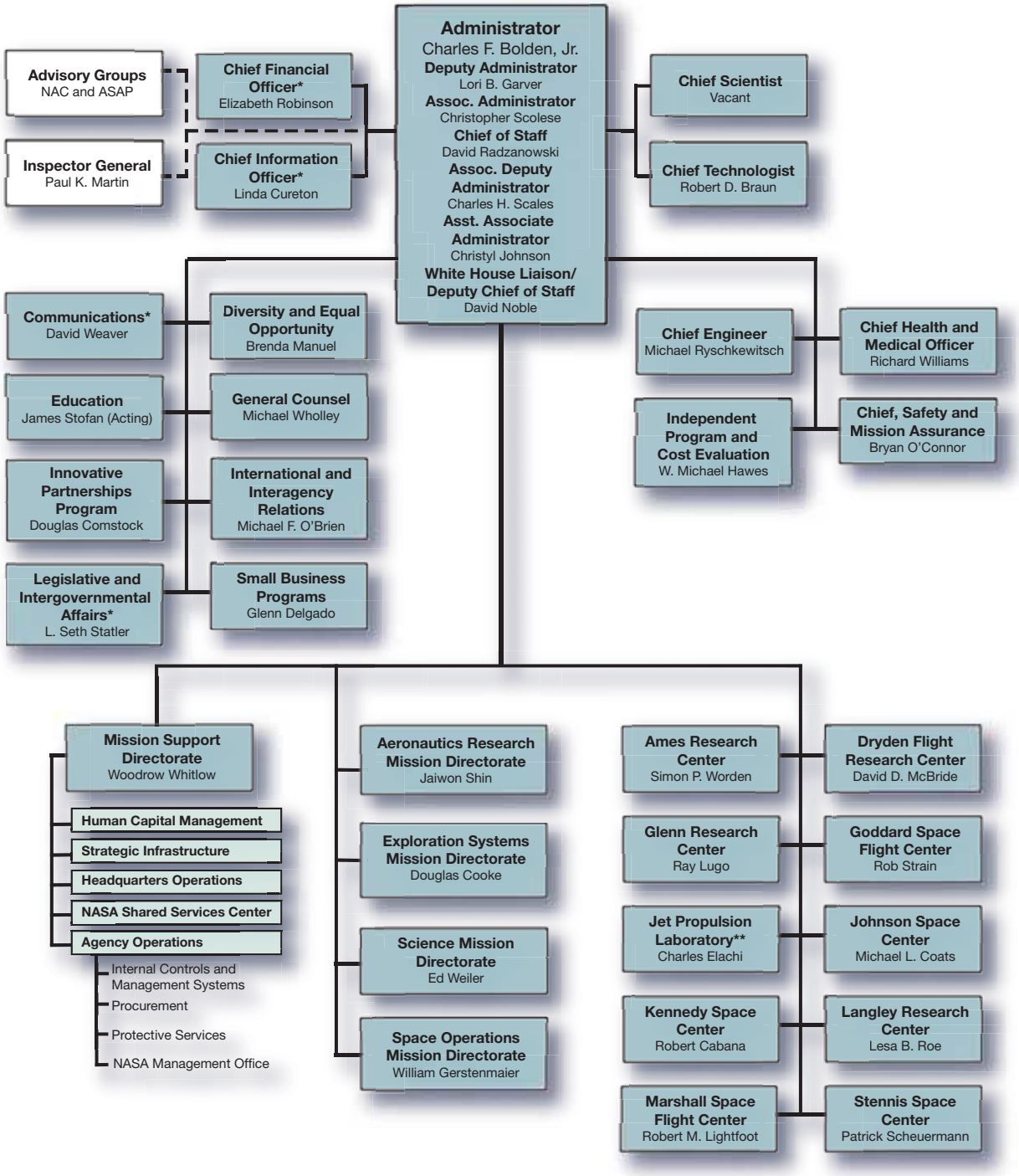
Other NASA facilities include: 1) Plum Brook Station, Sandusky, OH, managed by GRC; 2) Software Independent Verification and Validation Facility, Fairmont, WV, managed by GSFC; 3) Goddard Institute for Space Studies, New York, NY, managed by GSFC; 4) Wallops Flight Facility, Wallops, VA, managed by GSFC; 5) Michoud Assembly Facility, New Orleans, LA, managed by MSFC; and 6) White Sands Test Facility and Space Network, White Sands, NM, managed by JSC.

NASA's science, research, and technology development work is focused and implemented through four Mission Directorates and supported by one Mission Support Directorate:

- The **Aeronautics Research Mission Directorate (ARMD)** conducts fundamental research in aeronautical disciplines and develops capabilities, tools, and technologies that will significantly enhance aircraft performance, safety, and environmental compatibility, as well as increase the capacity and flexibility of the U.S. air transportation system.
- The **Science Mission Directorate (SMD)** conducts the scientific exploration of Earth, the Sun, the solar system, and the universe. SMD's missions include ground-, air-, and space-based observatories, deep-space automated spacecraft, and planetary orbiters, landers, and surface rovers. SMD also develops innovative science instruments and techniques in pursuit of NASA's science goals.
- The **Exploration Systems Mission Directorate (ESMD)** develops the capabilities for long-duration human and robotic exploration. ESMD is conducting robotic precursor missions, developing human transportation elements, creating innovative life support and medical technologies, and establishing international and commercial partnerships. On February 1, 2010, the President released the FY 2011 Budget Request, which proposed several new programs that seek to foster sustainable human space exploration. Study teams are exploring the program options and the optimal path for making NASA's near- and long-term goals possible.
- The **Space Operations Mission Directorate (SOMD)** directs spaceflight operations, space launches, and space communications and manages the operation of integrated systems in low Earth orbit and beyond, including the ISS. SOMD is laying the foundation for future missions beyond Earth orbit by using the ISS as an orbital outpost where astronauts can test systems and technology.
- The **Mission Support Directorate** (created in February 2010) strengthens the efficiency and management of Agency level operations under a single Associate Administrator. These Agency-level activities include Center Management and Operations, Agency Management and Operations, Construction of Facilities, Human Capital and Infrastructure.

For more detailed information about NASA's organization go to *http://www.nasa.gov/about/org_index.html*.

NASA's Organization Structure



NASA organization as of September 30, 2010.

*Center functional office directors report to Agency functional Associate Administrators. Deputy and below report to Center leadership.

**The Jet Propulsion Laboratory is a FFRDC operated under a contract with the California Institute of Technology.

White boxes indicate independent organizations that report to the Administrator.

NASA's Workforce

NASA employs over 18,000 civil servants at nine Centers, Headquarters, and the NASA Shared Services Center, with an additional 5,000 people at the Jet Propulsion Laboratory. At every NASA location across the country, NASA employees work to contribute their time and talents to the local community.

NASA improved its already-high score in the Partnership for Public Service's Best Places to Work survey of Federal agencies as identified by employees, increasing the Agency's overall index score by 3.5 percent over 2009 and ranking fifth out of 32 agencies reviewed (see *http://data.bestplacestowork.org/bptw/index* for more information). NASA's ratings improved in Strategic Management, Effective Leadership, Performance Based Rewards and Advancement, Training and Development, and Pay. However, the survey also revealed areas in need of improvement such as Teamwork, which dropped from a rating of 80.0 in 2009 to 75.9 in 2010. Teamwork is a NASA Value, and NASA's employees constantly strive to strengthen workforce collaboration.

Shared Values, Shared Results

NASA has four shared core values that support and guide the Agency's commitment to technical and professional excellence. Every NASA employee believes that mission success is the natural outcome of an uncompromising commitment to safety, integrity, teamwork, and excellence.

Safety: Constant attention to safety is the cornerstone of NASA's mission success. NASA is committed, individually and as a team, to protecting the safety and health of the public, NASA team members, and the assets that the Nation entrusts to the Agency.

Integrity: NASA is committed to maintaining an environment of trust, built upon honesty, ethical behavior, respect, and candor. Agency leaders enable this environment by encouraging and rewarding a vigorous, open flow of communication on all issues, in all directions, and among all employees without fear of reprisal. Building trust through ethical conduct as individuals and as an organization is a necessary component of mission success.

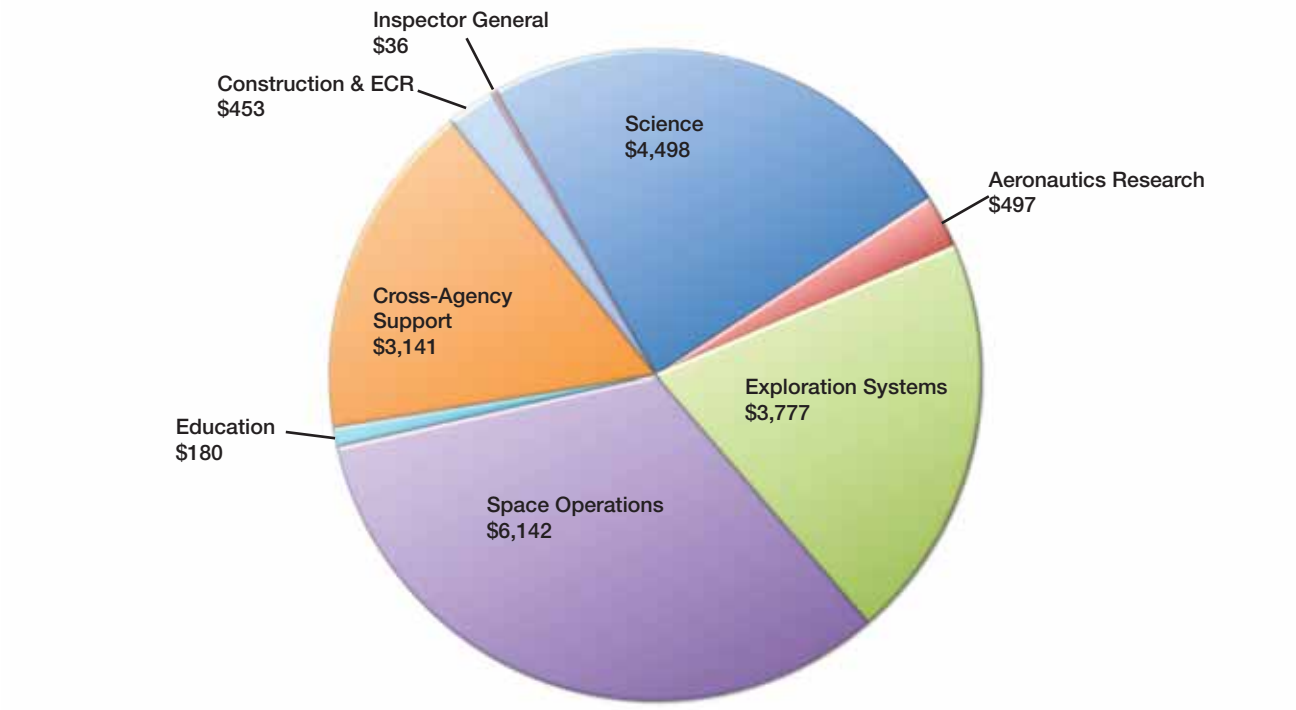
Teamwork: NASA strives to ensure that the Agency's workforce functions safely at the highest levels of physical and mental well-being. The most powerful tool for achieving mission success is a multi-disciplinary team of diverse, competent people across all NASA Centers. NASA's approach to teamwork is based on a philosophy that each team member brings unique experience and important expertise to project issues. Recognition of and openness to the insight of individual team members improves the likelihood of identifying and resolving challenges to safety and mission success. The Agency is committed to creating an environment that fosters teamwork and processes that support equal opportunity, collaboration, continuous learning, and openness to innovation and new ideas.

Excellence: To achieve the highest standards in engineering, research, operations, and management in support of mission success, NASA is committed to nurturing an organizational culture in which individuals make full use of their time, talent, and opportunities to pursue excellence in both the ordinary and the extraordinary.

Budget for Performance: NASA's FY 2010 Budget

NASA's FY 2010 budgetary resources totaled $18,724 million, an increase of about five percent from NASA's FY 2009 budget. This increase demonstrates a commitment to funding the balanced priorities set forth for the Agency in space exploration, Earth and space science, and aeronautics research. Operating plan changes reflect budget changes necessary to carry out Congressional and White House directives that occurred after the FY 2010 budget request. NASA's budget requests are available online at *http://www.nasa.gov/news/budget/index.html*.

NASA's FY 2010 Enacted Budget Total, Including July Operating Plan Adjustments: $18,724
(Dollars in Millions)



ECR is Environmental Compliance and Restoration. Construction and Environmental Compliance and Restoration became a budgetary line item as of the FY 2011 budget request, and it appears in NASA's FY 2010 operating plans.

Proud to Serve the Nation: American Recovery and Reinvestment Act

The American Recovery and Reinvestment Act of 2009 (Recovery Act) was signed into law by President Obama on February 17, 2009. It was an unprecedented effort to jump start the Nation's economy, create and save millions of jobs, and modernize the Nation's infrastructure so the country can thrive in the 21st century.

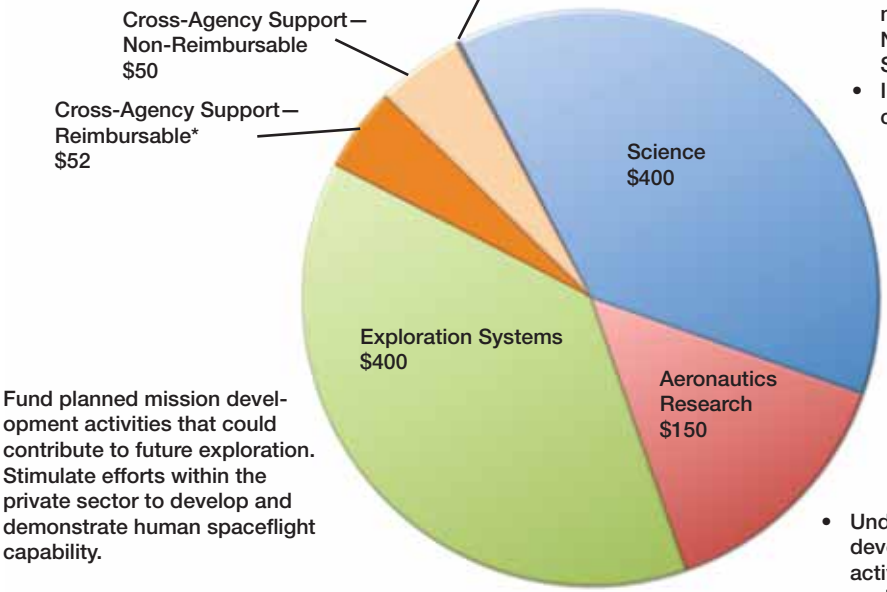
NASA received $1,050 million of Recovery Act funding in fiscal year 2009 ($1,002 million Direct Appropriation and $48 million Reimbursable Authority), all of which has been obligated on projects to support the Nation's economic recovery and advance NASA's research mission. The Agency received an additional $4 million in Recovery Act Reimbursable Authority in FY 2010. Details on the Agency's progress are available at *http://www.nasa.gov/recovery/index.html*. From satellites that track and trend weather and natural hazards to creating a safer, more

efficient air transportation system, NASA's employees are proud to contribute to the breakthroughs and activities that will aid America's economic recovery.

Among the key purposes of the Recovery Act are preserving and creating jobs, spurring technological advances in science and health, and promoting economic recovery. NASA has an important role to play in achieving these purposes through the program and facilities investments it is making with Recovery Act funding.

NASA Recovery Act Funding Total: $1,054
(Dollars in Millions)

- Restore NASA-owned facilities damaged by hurricanes and other natural disasters that occurred in 2008.



- Accelerate the development of Earth Science climate research missions recommended by the National Academies' Decadal Survey.
- Increase NASA's supercomputing capabilities.

- Fund planned mission development activities that could contribute to future exploration.
- Stimulate efforts within the private sector to develop and demonstrate human spaceflight capability.

- Undertake systems-level research, development, and demonstration activities related to aviation safety, environmental impact mitigation, and development of the Next Generation Air Transportation system (NextGen).

*Reimbursable activities for other Federal agencies' Recovery Act programs.

Performance Results

Managing and Measuring NASA's Performance

The Government Performance and Results Act of 1993 (GPRA) requires Federal agencies to issue plans for how the Agency intends to accomplish its mission. This process starts with a strategic plan that sets the mission and outlines an agency's goals and objectives for at least five years. The agency's annual performance plan then describes the performance indicators and program outputs needed to achieve the goals and objectives.

NASA's 2006 Strategic Plan established six Strategic Goals, with six Sub-goals under Strategic Goal 3.

Strategic Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.

Strategic Goal 2: Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.

Strategic Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

Strategic Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.

Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Strategic Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

Each of the six Strategic Goals is clearly defined and supported by multi-year Outcomes that enhance the Agency's ability to measure and report accomplishments. NASA also set Annual Performance Goals (APGs) that demonstrate progress for achieving Outcomes. The APGs are updated annually as part of the Performance Plan, included in NASA's annual Budget Estimates (available at *http://www.nasa.gov/news/budget/index.html*).

In addition to Outcomes and APGs for NASA's Strategic Goals, the Agency also has performance measures for Cross-Agency Support functions as well as Uniform and Efficiency Measure APGs. These measures help NASA to track performance in a number of program and project management areas, including life cycle schedule and cost, and competitive award processes. NASA organizes Efficiency Measure APGs by NASA's Budget Themes to emphasize and encourage individual program accountability.

NASA measures and communicates its progress toward achieving Outcomes and APGs through color ratings (Green, Yellow, Red, and White). NASA managers in the Mission Directorates and Mission Support Offices determine ratings for the multi-year Outcomes and APGs based on a series of internal and external assessments that are part of ongoing monitoring requirements in NASA's Performance Management System.

What do the color ratings mean?		
Color	**Multi-year Outcome Rating**	**Annual Performance Goal Rating**
Green	NASA achieved most APGs under this Outcome and is on-track to achieve or exceed this Outcome.	NASA achieved this APG.
Yellow	NASA made significant progress toward this Outcome; however, the Agency may not achieve this Outcome as stated.	NASA failed to achieve this APG, but made significant progress and anticipates achieving it during the next fiscal year.
Red	NASA failed to achieve most of the APGs under this Outcome and does not expect to achieve this Outcome as stated.	NASA failed to achieve this APG and does not anticipate completing it within the next fiscal year.
White	This Outcome was canceled by management directive or is no longer applicable based on management changes to the APGs.	This APG was canceled by management directive and NASA is no longer pursuing activities relevant to this APG, or the program did not have activities relevant to the APG during the fiscal year.

Managers rely on feedback from advisory groups and experts in the field to guide their rating decisions. Advisory groups like the NASA Advisory Council, the National Academies, and the Aerospace Safety Advisory Panel assess program content and direction. Experts from the science community also review the progress that projects and programs make toward meeting the performance measures under Sub-goals 3A through 3D, and managers assign ratings to the science-related Outcomes and APGs based on these experts' findings. The next page shows a breakdown of the FY 2010 performance results by percentages of Green, Yellow, Red, and White ratings for the Outcomes and APGs.

NASA's performance data provides a foundation for both programmatic and institutional decision-making processes and supports decisions concerning strategy and budget. Internally, the Agency monitors and analyzes how each program manages its budget and schedule. These analyses are provided during quarterly and monthly reviews at the Center, Mission Directorate, and Agency levels to communicate the health and performance of a program. The final performance results reflected in this report help inform planning for the forthcoming 2011 Strategic Plan and the FY 2012 budget request.

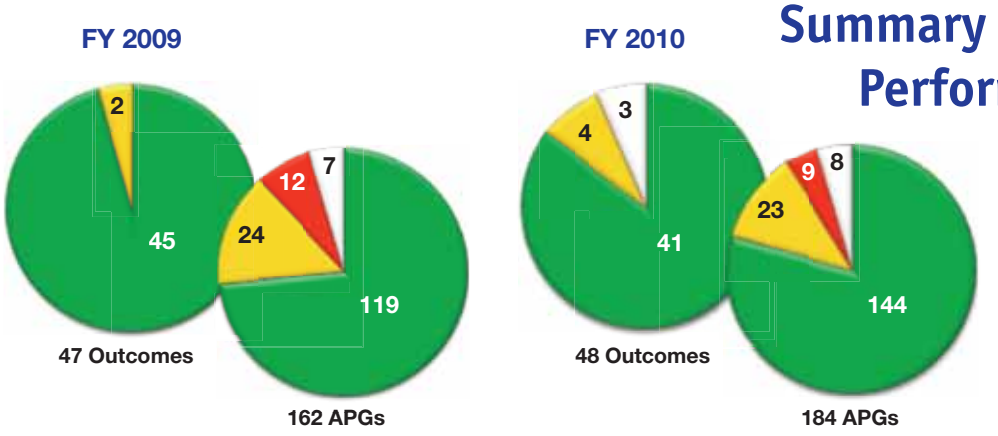
As part of the planning process, Mission Directorates are working to implement internal success criteria into their APGs and related projects. This internal rating process will help to determine whether each project is meeting its goal while emphasizing a more quantitative approach to performance measurement and rating. Nonetheless, advisory groups and expert advisors will continue to play an important role in rating decisions.

FY 2010 Cost Toward Strategic Goals

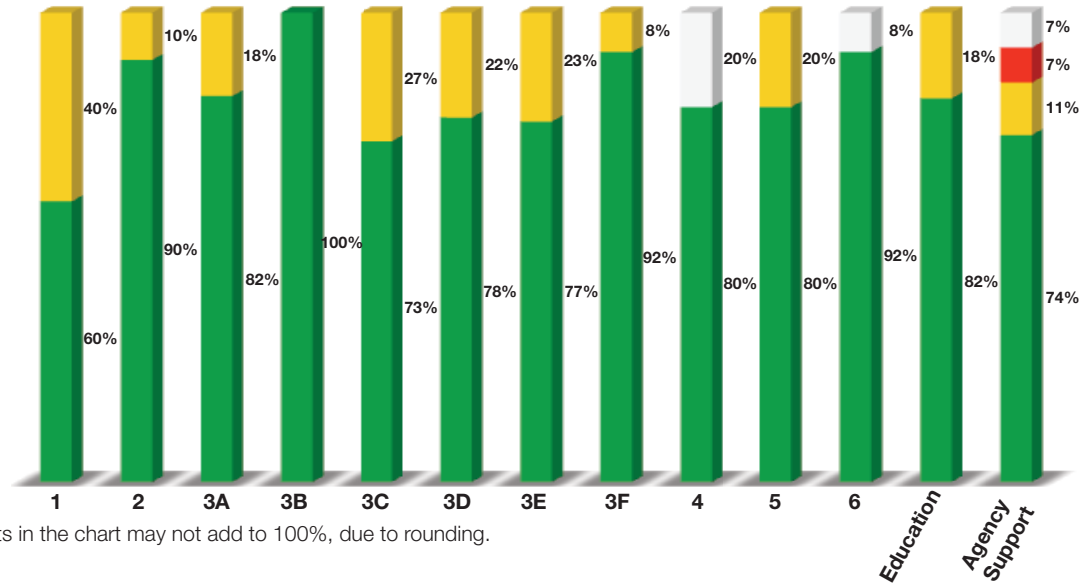
To measure cost toward Strategic Goals and Sub-goals, NASA maps the Mission Directorate's costs (i.e., Research and Development Initiatives as presented in the Statement of Net Cost) to the Strategic Goals and Sub-goals through Themes and programs. In 2003, NASA created Themes as a bridge to connect related Agency programs and projects to the Mission Directorates or equivalents that manage the programs. Themes group together similar programs, such as the programs that conduct Earth science or support the Agency's spaceflight missions, into budgeting categories. NASA uses Themes and programs to track performance areas, with Themes often contributing to a single Strategic Goal or Sub-goal.

NASA analyzes the fiscal year's final operating plan (this year issued in July) to determine the portion of each Mission Directorate budget allocated to each Theme and/or program, thus tying it to a particular Strategic Goal or Sub-goal. The Agency's analysts then use NASA's Statement of Net Cost to allocate Research and Development Initiatives cost to the Themes and then Strategic Goals and Sub-Goals based on the relationships determined in the operating plan.

Summary of NASA's Performance



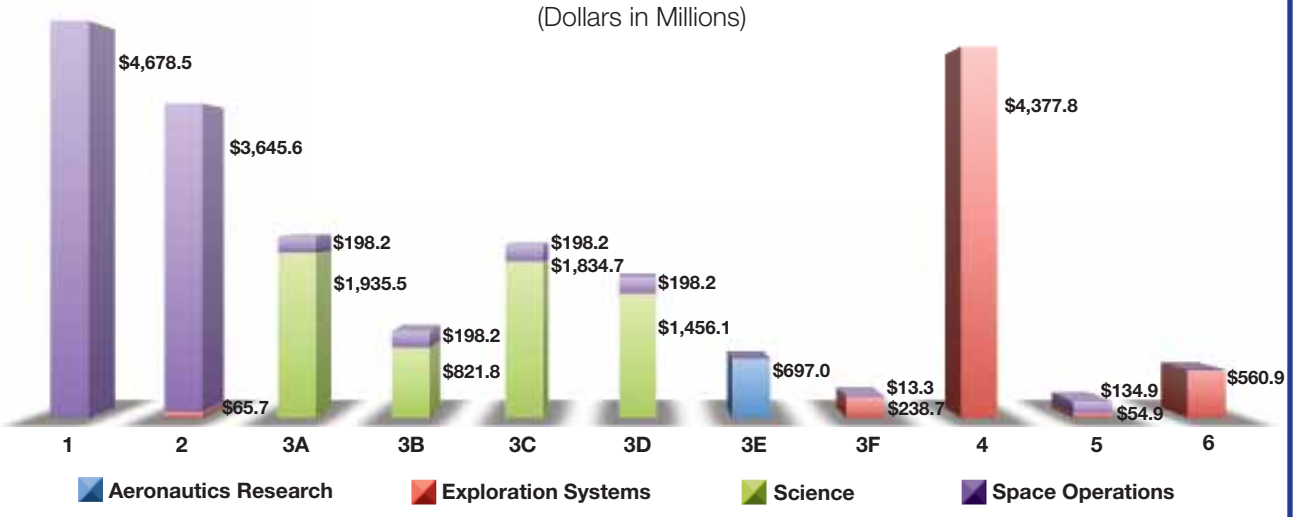
FY 2010 APG Ratings by Strategic Goal or Equivalent



Amounts in the chart may not add to 100%, due to rounding.

FY 2010 Cost by Strategic Goal

(Dollars in Millions)



Total cost is $21,308.0

Amounts in the chart may not agree with the total, as per the Statement of Net Cost, or totals in *Detailed Performance* due to rounding.

Performance Highlights

The following section highlights NASA's significant achievements and efforts under each Strategic Goal in FY 2010. For complete ratings and narratives describing NASA's progress toward achieving the Agency's APGs, multi-year Outcomes and Strategic Goals, please see the *Detailed Performance* section. For more information on NASA's missions, please see the NASA's Missions at a Glance located in the *Other Accompanying Information* section of this document.

Strategic Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.

Responsible Mission Directorate: Space Operations

This Highlight achieved in pursuit of Outcome 1.1 in NASA's FY 2010 Performance Plan Update.

A Busy Year for the Space Shuttle and Its Crews

The Space Shuttle safely and successfully completed every mission objective for all four flights in FY 2010.

The focus of the Space Shuttle flights to the ISS this year was on delivering the final pressurized elements and provisioning the Station to support operations and utilization through the next 10 years and potentially beyond. Due to operational considerations, NASA extended the STS-133 and STS-134 missions into FY 2011. NASA maintains the option of flying one additional mission, STS-135, if so directed using flight hardware already in place to support contingency rescue operations for STS-134. This action was taken with the express consent of all stakeholders to ensure the safety of these flights and the ongoing success of the ISS partnership.

The STS-129 mission, launched on November 16, 2009, focused on staging spare components on the outside of the ISS, including gyroscopes, nitrogen and ammonia tank assemblies, pump modules, and end effectors for the ISS robotic arm.

STS-130, launched on February 8, 2010, saw the delivery and installation of the Tranquility (formerly Node 3) module and the Cupola. The name for the Tranquility module was suggested through a NASA public outreach effort, tying together the installation of the last planned U.S. pressurized module with history of space exploration and the landing of Apollo 11 at Tranquility Base on the Moon in July 1969.

STS-131, launched on April 5, 2010, carried the Italian-built Multi-Purpose Logistics Module (MPLM) Leonardo loaded with eight tons of science equipment and cargo. Leonardo will return to the ISS one last time on STS-133 when it is permanently installed to the station.

The final mission of the fiscal year, STS-132, was launched on May 14, 2010, carrying the final scientific module destined for ISS, the Russian Rassvet Mini Research Module, as well as over 5,300 pounds of external supplies on an Integrated Cargo Carrier–Vertical Light Deployable (ICC-VLD) pallet in the cargo bay. As part of the process of retiring the Space Shuttle, the last set of Solid Rocket Motors (RSRM-114) and the last production External Tank (ET-138) were delivered to the Kennedy Space Center.

Credit: NASA

The Canadarm2 transfers the Tranquility module from Endeavour's payload bay to its new position on the port side of the ISS Unity node (visible in the upper left corner) on February 11, 2010.

Strategic Goal 2: Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.

Responsible Mission Directorate: Space Operations

This Highlight achieved in pursuit of Outcomes 2.1 and 2.2 in NASA's FY 2010 Performance Plan Update.

ISS Gets New Windows on the World and Research Facilities

FY 2010 was a very busy year onboard the ISS. In November 2009, the Shuttle mission STS-129 delivered close to 30 thousand pounds of replacement parts packed onto two Express Logistics Carriers which ISS crew members transferred and attached to the ISS truss. NASA stationed the spare parts on the ISS in anticipation of the Shuttle's retirement in 2011. In February 2010, the STS-130 Shuttle mission delivered and installed the Tranquility module and dome-shaped, window-filled Cupola. The Cupola has seven windows, six around the sides and one on top. Just under ten feet in diameter, the module will accommodate two crew members and portable workstations that can control station and robotic activities. The multi-directional view will allow the crew to monitor spacewalks and docking operations, as well as provide a spectacular view of Earth and other celestial objects.

Credit: NASA

STS-130 astronaut Nicholas Patrick works on the newly installed Cupola on February 10, 2010. During the spacewalk he and fellow astronaut Robert Behnken removed the insulation blankets and launch restraint bolts from each of the Cupola's seven windows.

In April 2010, the STS-131 mission delivered over 17 thousand pounds of equipment to the Station in the multi-purpose logistics module Leonardo. This mission also marked the first time four women were in space and the first time Japan had two of its astronauts in space at the same time.

An important part of achieving Strategic Goal 2 is turning the ISS into an effective on-orbit research laboratory for testing technologies and capabilities for space exploration and Earth applications. As part of the International Partner commitments, the crew share facilities and execute scientific experiments from all partners, making the most of available resources as the outpost approaches full operations. In addition to the scientific racks and experiments already on board, the STS-131 mission delivered four new utilization racks to the station: The Window Observational Research Facility (WORF), the Muscle Atrophy Research and Exercise System (MARES), the EXpedite the PRocessing of Experiments to Space Station (ExPRESS) Rack 7, and the Minus Eighty-Degree Laboratory Freezer for ISS (MELFI). In May 2010, the STS-132 mission delivered the Russian Mini Research Module Rassvet (meaning dawn) along with a new backup space-to-ground antenna and replacement batteries for the station power system. The Rassvet contains eight workstations designed for a variety of space experiments and educational research. It also will provide an additional docking port for Russian Soyuz and Progress vehicles.

More information on the many ISS experiments conducted during each Expedition can be found at www.nasa.gov/mission_pages/station/main/index.html.

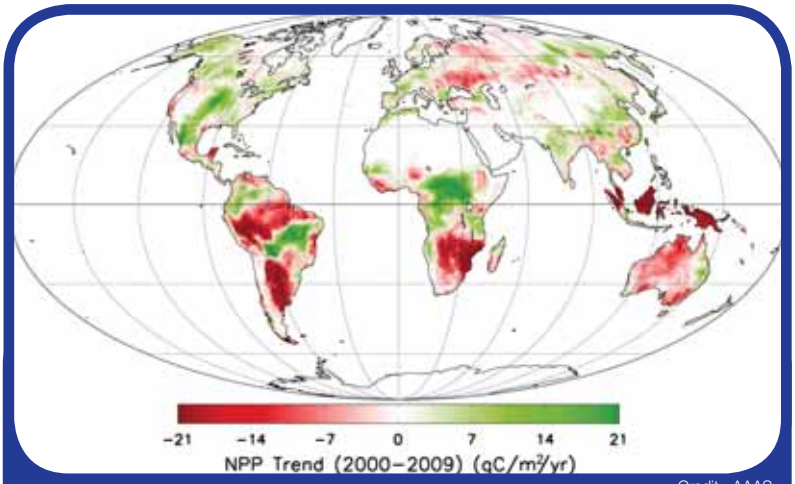
Sub-Goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.

Responsible Mission Directorate: Science

This Highlight achieved in pursuit of Outcome 3A.3 in NASA's FY 2010 Performance Plan Update.

NASA Measures Changes in Plant Productivity

At the base of Earth's food web are terrestrial plants and algae, the organisms responsible for primary production, the production of organic compounds from carbon dioxide and water. Almost all life on Earth is directly or indirectly reliant on these primary production organisms. NASA research has succeeded in quantifying global land cover and examining trends and processes in ecosystems, revealing the impact of drought on plant production and Earth's ecosystems.



Credit: AAAS

NASA-funded researchers analyzed time series data from Terra's Moderate Resolution Imaging Spectroradiometer (MODIS) in combination with climate data. Areas in green had increased net primary productivity and those colored red had decreased net primary productivity. Over the Northern Hemisphere, 65 percent of vegetated land area had increased net primary production, while in the Southern Hemisphere, 70 percent of vegetated land areas had decreased net primary productivity.

Net primary production quantifies the amount of atmospheric carbon fixed by plants and accumulated as biomass, the living component of Earth's ecosystems. Past research has shown that increased temperatures and solar radiation around the globe have allowed an upward trend in terrestrial net primary production from 1982 through 1999. From data obtained from air- and space-borne sensors, NASA has produced new maps of forests and wetlands and has further studied changes in global land cover, forest heights, ocean productivity, and terrestrial biomass accumulation following disturbances. A new study based on ten years of satellite data reported that the previously observed increasing trend in terrestrial primary production has reversed and now shows a weak decline. The recent analysis shows that since 2000, high-latitude northern hemisphere forests have continued to benefit from warmer temperatures and a longer growing season. However, in the southern hemisphere widespread persistent droughts have resulted in a net global loss of terrestrial productivity. A continued decline in global terrestrial plant productivity potentially threatens food security and future biofuel production and weakens the terrestrial carbon sink, leaving more carbon in the atmosphere. Continuous global monitoring is essential to determine whether the reduced net primary production is a decadal variation or a turning point in terrestrial primary production resulting from a changing climate.

More on this research is available online at: http://www.nasa.gov/topics/earth/features/plant-decline.html.

Sub-Goal 3B: Understand the Sun and its effects on Earth and the solar system.

Responsible Mission Directorate: Science

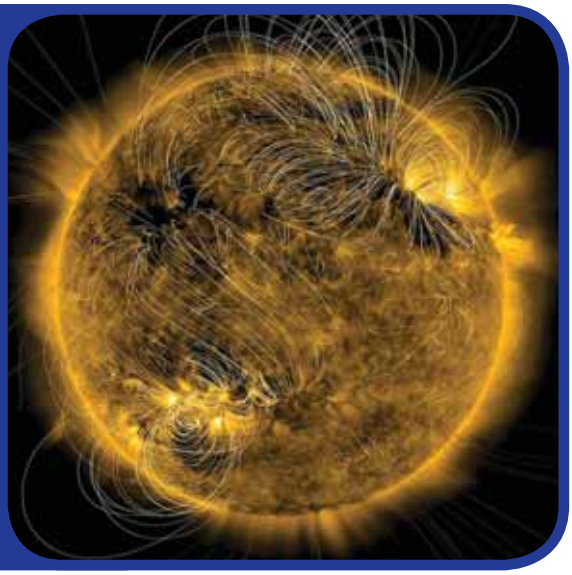
This Highlight achieved in pursuit of Outcome 3B.2 in NASA's FY 2010 Performance Plan Update.

NASA Heliophysics Spacecraft Show the New and Unexpected

Launched in February 2010, the Solar Dynamics Observatory (SDO) is returning images that show never-before-seen detail of material, including energetic particles and radiation, streaming outward and away from sunspots.

This image, taken on August 20, 2010, by SDO, shows that the Sun's corona is threaded with a complex network of magnetic fields. Some field lines are closed (the white lines), not releasing solar wind, and some lines (the gold lines) show open fields, letting solar wind escape. Understanding these magnetic fields is important because it is thought that solar storms and flares,which can affect life on Earth, result from changes in the structure and connections of these fields. The SDO images show the corona's eruptions of superheated gases and intense magnetic fields that are constantly on the move.

Credit: NASA



These immense clouds of material, when directed toward Earth, cause large magnetic storms in the magnetosphere and upper atmosphere. Other images show extreme close-ups of activity on the Sun's surface, revealing how the solar magnetic field is generated in the solar interior and how its structure evolves in the solar atmosphere. SDO's goal is to understand how the magnetospheric storms that the solar variations are able to produce influence life on Earth and humanity's technological systems.

For more on SDO, visit: *http://science.nasa.gov/science-news/science-at-nasa/2010/05feb_sdo/*.

Measurements from the older Coupled Ion Neutral Dynamic Investigation (CINDI) have unexpectedly shown that Earth's thermosphere contracted far more than expected during the recent solar minimum in 2009. Solar minimum is the period of the least activity in the 11-year solar cycle, when sunspot and solar flare activity diminishes. The record contraction results from the compound effects of an unusual lull in solar activity combined with enhanced radiative cooling at the upper reaches of Earth's atmosphere due to elevated carbon dioxide levels compared to previous solar minima. The extended solar minimum also has allowed the highest intensity of galactic cosmic rays of the space era to impact the atmosphere, with intensities as much as 20 percent greater than during previous solar minima. Studies of the radiation dose resulting from the enhanced 2009 cosmic ray intensities suggest that NASA and its partners may need to re-evaluate how much radiation shielding astronauts take with them on deep-space missions.

For more on the solar minimum and cosmic rays, visit: *http://science.nasa.gov/science-news/science-at-nasa/2009/29sep_cosmicrays/*.

Sub-Goal 3C: Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.

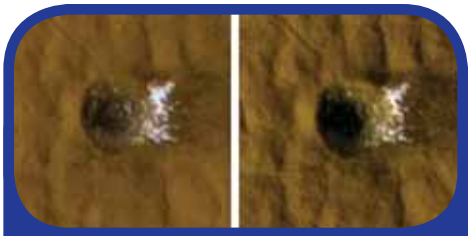
Responsible Mission Directorate: Science

This Highlight achieved in pursuit of Outcome 3C.3 in NASA's FY 2010 Performance Plan Update.

A Warmer, Wetter Mars

While the Mars of today is a world of cold deserts, there is evidence of a warmer and wetter past. Features resembling dry riverbeds and minerals that form in the presence of water indicate water once flowed through Martian sands. Since liquid water is required for all known forms of life, scientists wonder if life could have arisen on Mars, and if it did, what became of it as the Martian climate changed. NASA's Mars Reconnaissance Orbiter (MRO) is helping researchers "follow the water" to determine the possible past, present, and future habitability of Earth's planetary neighbor.

New results from extensive radar mapping of the middle-latitude region of northern Mars show that thick masses of buried ice are quite common beneath protective coverings of dirt and rubble. MRO is charting the locations of these subsurface glaciers and ice-filled valleys, providing clues about how these deposits may have been left as remnants when regional ice sheets sublimated. Researchers hypothesize that the area was covered with an ice sheet during a different climate period, and when the climate dried out, these deposits remained only where they had been protected from the atmosphere. The ice could contain a record of environmental conditions at the time of its deposition and flow, making the ice masses an intriguing possible target for a future mission with digging capability.



Credit: NASA/JPL-Caltech/University of Arizona

This 40-foot-wide crater in mid-latitude northern Mars was created by an impact that occurred between July 3, 2004, and June 28, 2008. The impact that dug the crater excavated water-ice from below the surface, visible as the bright material inside and scattered to the right of the crater.

MRO revealed these glaciers hiding just below the surface of mid-latitude Mars. The spacecraft's observations were obtained from orbit after meteorites excavated fresh craters, revealing the water-ice. The orbiter observed bright ice exposed at five sites with new craters that range in depth from approximately one and a half feet to eight feet. The bright patches darkened in the weeks following initial observations, as the freshly exposed ice vaporized into the thin Martian atmosphere and left behind dust that had been intermixed with the ice. One of the new craters had a bright patch of material large enough for one of the orbiter's instruments to confirm it as water-ice. The findings confirm that water-ice occurs beneath Mars' surface halfway between the north pole and the equator, a lower latitude than expected in the Martian climate.

Sub-Goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

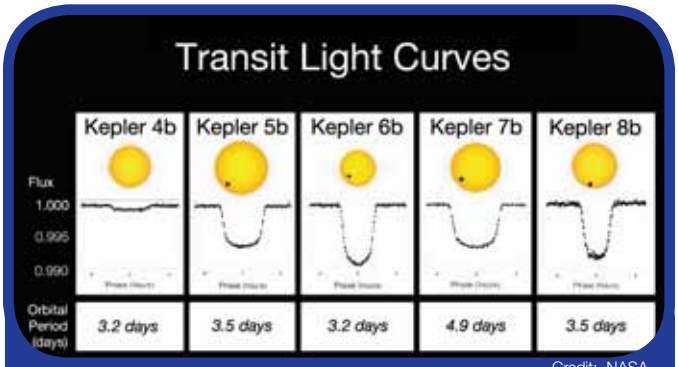
Responsible Mission Directorate: Science

This Highlight achieved in pursuit of Outcome 3D.4 in NASA's FY 2010 Performance Plan Update.

The Search for Earth-like Planets Heats Up

NASA's Kepler Space Telescope, launched in March 2009 to search for Earth-size planets in the habitable zone of sun-like stars, has discovered its first five new exoplanets, or planets beyond Earth's solar system.

Known as "hot Jupiters" because of their large size and extreme temperatures, the new exoplanets (named Kepler 4b, 5b, 6b, 7b, and 8b) range in size from similar to Neptune to larger than Jupiter. They have orbits ranging from 3.3 to 4.9 days, meaning they orbit very close to their parent stars. All the parent stars are hotter and larger than the Sun, and the estimated surface temperatures of the planets range from 2,200 to 3,000 degrees Fahrenheit—hotter than molten lava and much too hot for any known forms of life.



Credit: NASA

When a planet crosses in front of its star as viewed by an observer, it is called a transit. Transits by terrestrial planets produce a small change in the star's brightness—a change that Kepler's sensitive science instrument, or photometer, can detect and measure. From these measurements scientists can determine the size of the distant planet. The five panels show light curves and relative sizes (compared to their parent star) for the five confirmed planets found by Kepler during the first 90 days of operation. Kepler 4b is roughly the size of Neptune, whereas the other four planets are about the size of Jupiter.

Kepler is designed to survey a portion of the Milky Way galaxy to discover extrasolar planets, and these early Kepler discoveries demonstrate the power of the mission to find distant worlds and contribute to the census of extrasolar planets. Over the next three years, Kepler will yield information on the frequency of Earth-sized planets around other stars.

For more information on these discoveries, please visit: *http://www.nasa.gov/mission_pages/kepler/news/kepler-5-exoplanets.html*.

Sub-Goal 3E: Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.

Responsible Mission Directorate: Aeronautics Research

This Highlight achieved in pursuit of Outcome 3E.5 in NASA's FY 2010 Performance Plan Update.

X-48B Takes to the Sky for First Phase Flight Tests

In Spring 2010, a team led by NASA and the Boeing Company completed the first phase of flight tests on the subscale, manta ray-shaped X-48B hybrid wing body aircraft at Dryden Flight Research Center.

Hybrid wing body aircraft configurations are promising candidates to reduce the environmental impact associated with aviation. In the mid-2000s, NASA identified low-speed flight controls as a development challenge for aircraft such as the hybrid wing body. This challenge has been the initial focus of research since then. The ultimate goal is to develop technology for an environmentally friendly aircraft that makes less noise, burns less fuel, and emits less noxious exhaust.

Credit: NASA/T. Landis

NASA Dryden engineer Gary Cosentino prepares the X-48B for flight.

The first phase began on July 20, 2007 and ended with the 80th flight on March 19, 2010. The flight test program utilized a composite-skinned, 8.5 percent scale model of the X48-B that can to fly up to 10,000 feet and 120 knots in its low-speed configuration. A pilot flies the aircraft remotely from a ground control station using conventional aircraft controls and instrumentation, while looking at a monitor fed by a forward-looking camera on the aircraft.

Sub-Goal 3F: Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.

Responsible Mission Directorates: Exploration Systems and Space Operations

This Highlight achieved in pursuit of Outcome 3F.4 in NASA's FY 2010 Performance Plan Update.

VCAM Provides a Breath of Fresh Air on the ISS

Keeping astronauts healthy and productive in space goes beyond medicine and exercise. It includes technologies that protect crewmembers while remaining practical and comfortable to use. NASA continuously strives to develop technologies that will make exploration safer. The Vehicle Cabin Atmosphere Monitor (VCAM), which identifies gases that are present in minute quantities in the ISS breathing air that could harm the crew's health, is one such technology. In the future, instruments like VCAM could accompany crewmembers during long-duration exploration missions. To successfully live and work in the environment of the ISS, the environment must be monitored to ensure the health of the crewmembers. Crewmembers can be more sensitive to air pollutants because of the closed environment. The impact of pollutants in this environment are magnified because the exposure is continuous. VCAM can provide a means for monitoring the air within enclosed environments, such as the ISS, Crew Exploration Vehicle (CEV), or other vehicle traveling throughout the solar system. Its miniature preconcentrator, gas chromatograph, and mass spectrometer can provide unbiased detection of a large number of organic

species. VCAM's software can identify whether the chemicals are on a targeted list of hazardous compounds and their concentration. The performance and reliability of VCAM on orbit along with the ground teams assessment of its raw data and analysis results will support the development of this technology in the future.

For more on NASA's research to keep astronauts healthy and productive, go to *http://humanresearch.jsc.nasa.gov* and *http://www.nasa.gov/exploration/analogs/index.html*.

Strategic Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.

Responsible Mission Directorate: Exploration Systems

This Highlight achieved in pursuit of Outcome 4.1 in NASA's FY 2010 Performance Plan Update.

Ares I-X Completes a Successful Flight Test

The Ares I-X test rocket lifted off on October 28, 2009, from Kennedy Space Center for a two-minute powered flight, the first time that NASA's new 327-foot-tall launch vehicle had flown. The flight test, which launched from the newly modified Launch Complex 39B, lasted about six minutes until splash-down of the rocket's booster stage nearly 150 miles down-range. The successful flight test capped its easterly trajectory at a suborbital altitude of 150,000 feet.

After the separation of its first stage, a four-segment solid rocket booster, parachutes deployed for recovery of the booster and the solid rocket motor. The test launch met all its primary goals and provided a solid foundation for future rockets. The flight's only flaw came after the first stage burned through its fuel and separated from the dummy upper stage. One of the three main parachutes collapsed entirely during the fall to the ocean and a second partially collapsed, most likely because the device that cuts the reefing lines activated earlier than planned. A number of lessons were learned from the Ares I-X experience.

Engineers of future rockets can incorporate a number of policies, techniques, and experiences, to support quick maturation from concept to operational launcher of the next generation of American spaceflight vehicles that could transport humans beyond low Earth orbit.

For more on the Ares I-X test flight, go to: *http://www.nasa.gov/mission_pages/constellation/ares/flighttests/aresIx/index.html*.

Credit: NASA/S. Joseph and K. O'Connel

NASA's Ares I-X test rocket soars into blue skies above Launch Pad 39B at NASA's Kennedy Space Center in Florida on October 28, 2009.

Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Responsible Mission Directorates: Exploration Systems and Space Operations

This Highlight achieved in pursuit of Outcome 5.1 in NASA's FY 2010 Performance Plan Update.

NASA Ensures Launch Options

In September 2010, NASA awarded new launch services contracts to four commercial companies to ensure NASA's access to a broad range of launch services over a ten-year period. Through these contracts, the Agency will have a variety of launch options for NASA's planetary, Earth-observing, exploration, and scientific satellites and will also be able to provide launch services to other government agencies, such as the National Oceanic and

Atmospheric Administration. NASA has the ability to order up to 70 launch services missions with a maximum cumulative potential contract value of $15 billion.

NASA selected the following companies: Lockheed Martin Space Systems Company for the Athena I and Athena II; Orbital Sciences Corporation for the Pegasus XL and Taurus XL; United Launch Services, LLC for the Atlas V, and Space Exploration Technologies (SpaceX) for the Falcon 1, 1e and 9 launch vehicles.

Although the new contract lasts for ten years, an annual opportunity exists for launch service providers to submit proposals offering new launch services unavailable at the time of this award, thus enhancing the competitive nature of the contract over the full ten-year contract life. NASA's Launch Services Program continues to engage emerging launch service providers, both on and off the contract, to provide expertise and to encourage the successful growth of a competitive market.

In 2010, SpaceX and Orbital continued to make progress under the signed Commercial Orbital Transportation Systems (COTS) Space Act Agreements and toward the signed Commercial Resupply Services (CRS) contracts to provide cargo resupply for the ISS.

On June 4, 2010, the SpaceX Falcon 9 rocket lifted off from Kennedy Space Center on its maiden flight. The Falcon 9 rocket successfully achieved its intended 155-mile-high orbit, fulfilling all mission objectives. This successful test by SpaceX is an important benchmark toward the launching of an active Dragon spacecraft on SpaceX's first COTS demonstration mission scheduled for November 2010.

Strategic Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

Responsible Mission Directorates: Exploration Systems and Space Operations

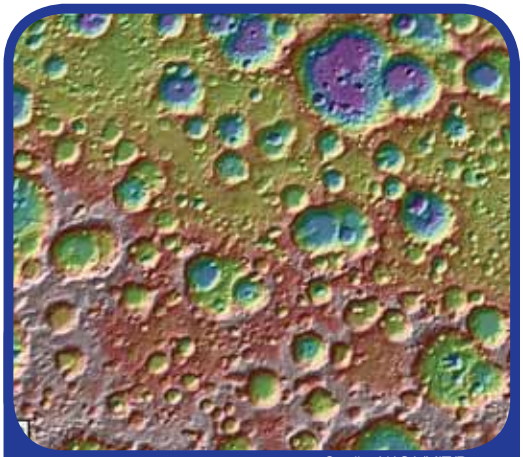
This Highlight achieved in pursuit of Outcome 6.4 in NASA's FY 2010 Performance Plan Update.

LRO Reveals New Moon

The instruments on LRO have supported the ability to study the Moon at a number of different scales, from the Moon as a whole, to regional variations, to discoveries at specific locations. The three papers published in the September 17, 2010, issue of the journal *Science* are examples of NASA's ability to gain intriguing new knowledge of the Moon over each of these different spatial scales.

The topographic data acquired from LRO's Lunar Orbiter Laser Altimeter (LOLA) provided significant new scientific insight into the early history and evolution of the Moon that will also influence understanding of the early days of Earth. Using the high resolution altimetry data, a new catalog of all craters on the Moon with a diameter of greater than 20 kilometers was created, and a new perspective on the Moon's turbulent and violent youth has been developed.

Global scale information about mineralogy of the Moon typically comes from analysis of the light from the Sun that is reflected from the Moon's surface. The measurements delivered from LRO use infrared (longer wavelength than visible) light that is emitted by the Moon and is characteristic of its composition. LRO's data has revealed the presence of silica-rich lunar soils at scales of a kilometer and larger. There is also evidence of granite-like formations as well as regions where quartz and silica-rich glass are found. These emissions have also confirmed the pristine lunar mantle is not exposed at the lunar surface at the kilometer scale. The observations provide compelling evidence that the Moon is a complex body that has experienced a wide range of volcanic-like processes. Before LRO's launch, it was common to think the Moon was comprised of two different kinds of areas, the dark lunar seas and the brighter highlands areas. Now, with the



Credit: NASA/MIT/Brown

This lunar topographic map showing one of the most densely cratered regions on the Moon. The topography is derived from over 2.4 billion shots made by LOLA. Colors indicate increasing elevation from blue to red.

exquisite measurements made with LRO, details indicate that things are much more complicated and a lot more interesting.

For more on this story, including more images, go to: *http://www.nasa.gov/mission_pages/LRO/news/turbulent-youth.html*.

Other Agency Successes

Education

This Highlight achieved in pursuit of Outcome ED.2 in NASA's FY 2010 Performance Plan Update.

A Summer of Innovation

NASA piloted the Summer of Innovation project in 2010 to engage students in science, technology, engineering, and mathematics (STEM) disciplines through out-of-school learning activities. State education stakeholders, NASA Field Centers, and other education partners offered STEM-related special events, teacher development, and family activities throughout the summer.

One goal of the Summer of Innovation was to increase the participation of low-income and minority students. The Idaho Space Grant, one of four organizations to receive NASA support for a statewide initiative, collaborated with three universities and a tribal college to better reach minority students from the states of Idaho, Montana, and Utah. Junior high students and teachers from tribal reservations and migrant Latino families participated in engaging activities in rocketry, robotics, cosmology, and Earth science. One parent commented, "[My son] looked forward to each and every single day, and has just now started talking about college and a possible future within NASA."

NASA Field Centers hosted many student and teacher focused events. The Teaching From Space Project at Johnson Space Center offered student design challenges and opportunities for students to showcase their work to their parents. The Langley Research Center hosted some activities specifically designed for homeschoolers and reached more than 1,500 students. The Jet Propulsion Laboratory hosted a large event that included visits by astronauts, music celebrities, and a number of education workshops for students. The Glenn Research Center collaborated with the Cincinnati Public Schools for a summer learning session and a series of activities that enabled interactions between students and NASA scientists and engineers.

Although the impact of the Summer of Innovation is still being assessed, the summer pilot engaged more than 78 thousand students through summer learning sessions. The program also implemented more than 150 events led by 130 participating partners at NASA Field Centers across the Nation. The story, however, is bigger than just numbers. Currently, NASA is planning a second Summer of Innovation, to continue the strides made in the summer of 2010 and to hopefully pave the way for students, parents, and teachers to engage in a lifetime of learning.

Credit: NASA

Student involvement encompasses both one-time, short duration enrichment activities and long-term, or sustained learning. In 2010, NASA piloted the Summer of Innovation projects, designed to increase engagement opportunities for middle school students.

Diversity and Equal Opportunity

This Highlight achieved in pursuit of Outcome AS.2 in NASA's FY 2010 Performance Plan Update.

New Process Addresses Harassment

In FY 2010, NASA deployed an Agency process, one of the first of its kind in the Federal government, devoted solely to addressing allegations of harassment. The new process further strengthens NASA's commitment to being a workplace free of harmful and sometimes unlawful conduct. The process is specifically designed to ensure that the Agency handles and resolves allegations of harassing conduct at the earliest possible opportunity. This is an important means of preventing unlawful discrimination as harassment that becomes severe and pervasive and is a form of discrimination under the law. The new procedures create the role of Center Anti-Harassment Coordinator, an individual charged with receiving allegations of harassment, monitoring the process from start to finish, and reporting annually on the number of allegations received and time in inventory. The new process calls for a prompt fact-finding into the matter and a decision by the appropriate management official as to the allegation and whether any additional action should be taken. Under the new process, it is expected that the time elapsed from allegation to decision on the matter will normally be 2-4 weeks, barring extenuating circumstances.

NASA Surveys Workforce About Diversity and Inclusion

In FY 2010, NASA deployed a first-ever Agency-wide Diversity and Inclusion Survey to evaluate employee perceptions on a host of diversity-inclusion issues such as the extent to which employees believe the Agency is transparent in its policies and the dissemination of critical information, and whether employees believe they are being treated fairly in the allocation of career enhancing opportunities. This knowledge of current perceptions of the workforce is critical in shaping NASA's long-term diversity-inclusion effort. NASA's survey will conclude in the first quarter of FY 2011. The Agency is eager to analyze the results to improve diversity and inclusion throughout NASA.

Bringing Attention to Equal Opportunity in STEM

In FY 2010, NASA completed dissemination of the publication "Title IX and STEM: Promising Practices for Science, Technology, Engineering, and Technology" to grant recipients." Since its issuance, this publication has been recognized by civil rights agencies, advocacy groups, and academia as a milestone in efforts to draw attention to and provide useful guidance to educational institutions on ensuring equal opportunity regardless of gender in STEM programs, where the numbers of women students remain low in a number of critical fields.

For more information, visit NASA's Office of Diversity and Equal Opportunity at: *http://odeo.hq.nasa.gov/index.html*.

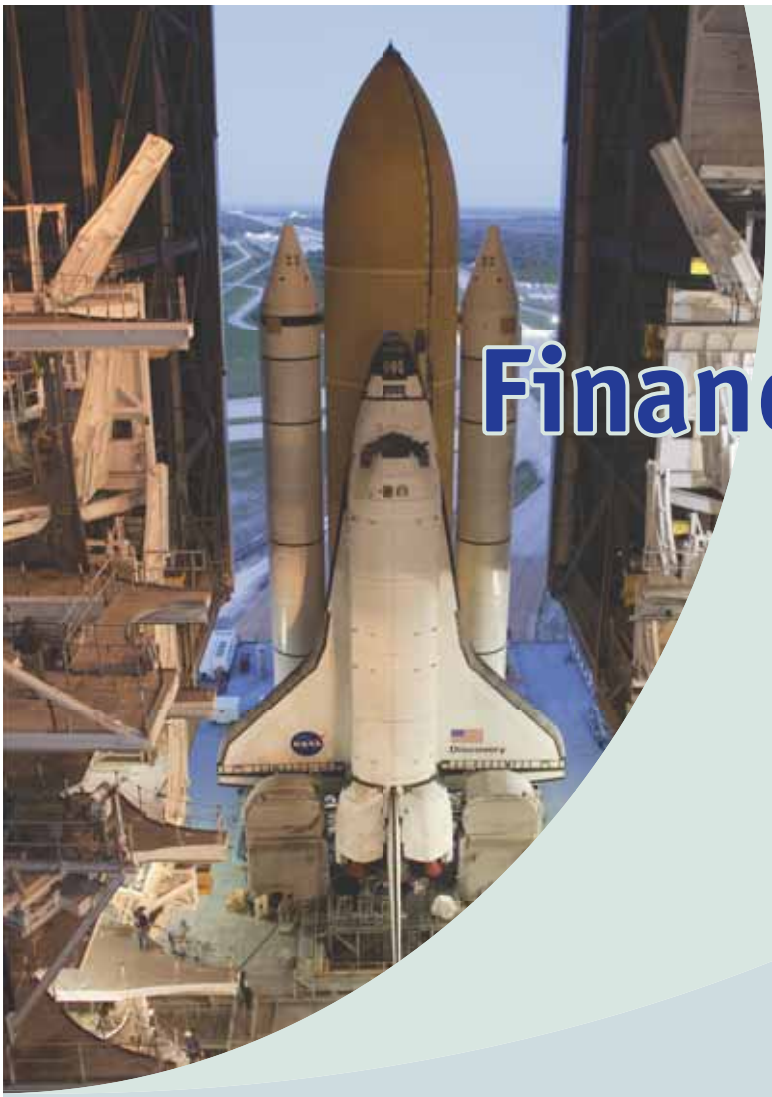
Verification and Validation of NASA's Performance Information

NASA verifies and validates its performance data to assure Congress and the public that reported performance information is credible. Verification and validation processes ensure that performance goals are measurable, with a direct connection to an Agency's mission, and that performance data is accurate, complete, consistent, and current. NASA has verified and validated that the Agency's Mission Directorates and Mission Support Offices have procedures in place for collecting, maintaining, and processing accurate GPRA performance data.

Each Mission Directorate and Mission Support Office has a process in place for assessing performance and assigning ratings to their Outcomes and APGs. NASA program officials enter supporting performance information into a secure Web-based system, which stores the information during and after the annual performance reporting process. Analysts within NASA's Strategic Investments Division (SID) in the Office of the Chief Financial Officer conduct additional reviews and evaluations of reported performance data to assess whether the information submitted by the Mission Directorates and Mission Support Offices is consistent with information reported at other internal reviews and complete enough to portray an accurate picture of NASA's performance.

In FY 2010, SID surveyed the Mission Directorates and Mission Support Offices on their verification and validation procedures via the secure Web-based system during the annual PAR data collection process. The survey required Mission Directorate and Mission Support Office officials to provide information about their processes for rating program performance, and maintaining and verifying data. Best practices identified during this process include holding monthly, biennial, and quarterly project and program reviews, with input from internal review boards, external advisory boards, and subject matter experts. Collaboration between Mission Directorates and Mission Support Offices ensures that the proper performance information is being shared throughout the Agency. Documentation utilized includes white papers, meeting minutes, meeting or conference presentations, letters and memos, a record of online correspondence, surveys, and spreadsheets and databases.

The Innovative Partnerships Program (IPP) offers an example of one office's thorough verification and validation process. All IPP program metrics are targeted to IPP's APGs and are compiled continuously in IPP's National Technology Transfer System (NTTS), which is a management information system that is utilized to compile key quantitative and qualitative information on licensing, partnership, patenting, and license fees/royalties activities. It includes success story information regarding commercial application of technologies transferred out of the Agency, as well as data regarding partnership joint technology development and infusion of these technologies into NASA's missions. SBIR/STTR, technology transfer, and partnership technology development success stories are verified directly with external entities. Further, NASA's Statement of Assurance annual process involves external, independent auditing of evidence provided by IPP to ensure that the program is meeting its mission objectives. IPP's program activity and achievements are documented almost continuously throughout the year on IPP's Web site at *http://www.nasa.gov/offices/ipp/home/index.html*.



Financial Results

This section analyzes and discusses NASA's Financial Statements and its stewardship of the resources provided to it by Congress to carry out its mission. The Financial Statements, which present the results of NASA's operations and financial position, are the responsibility of NASA's management.

NASA's financial statements and accompanying notes are presented in their entirety in the *Financials* section. NASA prepares the Consolidated Balance Sheet, Consolidated Statement of Net Cost, Consolidated Statement of Changes in Net Position and Combined Statement of Budgetary Resources, which provide the financial results of operations. This overview focuses on the key information provided in the statements, which describes NASA's stewardship of the resources provided to it by Congress to carry out its mission.

Financial Highlights

Results of Operations

NASA's net cost of operations for FY 2010 was $21.3 billion, a decrease of $1.2 billion, or five percent compared to FY 2009. This decrease primarily represents lower depreciation in FY 2010 due to the reduction of assets for the

On September 20, 2010, Space Shuttle *Discovery* begins its nighttime trek, known as "rollout," from the Vehicle Assembly Building to Launch Pad 39A. It will take the Shuttle, attached to its external fuel tank, twin solid rocket boosters and mobile launcher platform, about six hours to complete the move atop a crawler-transporter.

International Space Station (ISS) and Space Shuttle (SS) in late FY 2009. Most of NASA's Research and Development and Other Initiatives (R&D/Other) emphasized programs essential to achieving various strategic goals.

NASA's programs and activities are carried out through four R&D/Other initiatives: Aeronautics Research, Exploration Systems, Science, and Space Operations. The Consolidated Statement of Net Cost presents NASA's net costs by R&D/Other initiatives, which is summarized in the table below. The net cost of operations is the gross cost incurred by NASA, less any earned revenue for work performed for other government organizations and the public.

Space Operations and Science were NASA's largest expenditures in FY 2010 at $9.3 billion and $6.0 billion, respectively. The accompanying table provides net cost comparisons for FY 2010 and FY 2009 across the four major initiatives.

Cost by Research and Development and Other Initiatives
(In Millions of Dollars)

R&D/Other Initiatives	Audited 2010	Unaudited 2009	% Change
Aeronautics Research			
Gross Costs	$ 816	$ 828	-1%
Less: Earned Revenue	119	113	5%
Net Costs	697	715	-3%
Exploration Systems			
Gross Costs	5,360	5,153	4%
Less: Earned Revenue	62	33	88%
Net Costs	5,298	5,120	3%
Science			
Gross Costs	6,697	6,606	1%
Less: Earned Revenue	649	616	5%
Net Costs	6,048	5,990	1%
Space Operations			
Gross Costs	9,694	11,070	-12%
Less: Earned Revenue	429	428	0%
Net Costs	9,265	10,642	-13%
Net Cost of Operations			
Gross Costs	22,567	23,657	-5%
Less: Earned Revenue	1,259	1,190	6%
Net Costs	**$ 21,308**	**$ 22,467**	-5%

A significant portion of the decrease in net costs relates to general costs for goods and services used in operations across NASA programs, with the majority for the ISS. Remaining costs are allocated to R&D/other initiatives.

Aeronautics Research net costs decreased $18 million or three percent in FY 2010. Significant progress was made towards implementing the Next Generation Air Transportation System (NextGen), which is intended to yield revolutionary concepts, capabilities and technologies that will enable improvements in air vehicles and air traffic management.

Exploration Systems net cost was $178 million or three percent higher in FY 2010 primarily due to activity in the Constellation Program. In 2010, the Agency moved forward on existing program initiatives primarily focused on the Orion Crew Exploration Vehicle and the Ares 1 projects. The Orion crew exploration vehicle took shape as the two halves of the crew module were fused together. New efforts were taken to design, build and test the next generation human spacecraft Orion, including the construction of a crew module that will be used in flight-like environment testing on the ground. The Ares 1 project completed the first stage avionics, upper stage roll control systems and the launching for the Ares 1-X flight test.

Science net cost increased $58 million in FY 2010. This change of one percent primarily reflects planned acceleration of Earth Science, Decadal Survey Tier-1 missions, Soil Moisture Active-Passive, Ice, Cloud and Land Elevation Satellite 2, and the addition of a thermal infrared instrument to the Landsat Data Continuity Mission (LDCM), as well as planned fluctuation of costs for various other missions.

Space Operations net cost decreased $1.4 billion or thirteen percent in FY 2010. This is primarily due to the reduction of ISS and SS assets in late FY 2009 which resulted in lower depreciation. All SS missions will be completed by the end of FY 2011, after which the SS orbiters are scheduled to be retired. Space Operations completed activities to sustain engineering support and provide vehicle replacement spare parts, which will be essential once the Shuttle orbiters have been retired as there will not be return or repair capability. Space Operations also made significant progress on the Tracking and Data Relay Satellite (TDRS) Replenishment project to replenish the aging fleet of communications spacecraft in the space network.

Sources of Funding

NASA receives funds to support its operations primarily through congressional appropriations. NASA's total budgetary resources during FY 2010 totaled $21.5 billion, of which $1.3 billion is the unobligated balance brought forward from FY 2009. NASA's budgetary funding and use of funds is summarized in the table below.

Budgetary Resources
(In Millions of Dollars)

Line Item	Audited 2010	Unaudited 2009	% Change
New Budget Authority	$ 18,725	$ 17,784	5%
American Recovery and Reinvestment Act	4	1,050	-100%
Unobligated Balance Brought Forward	1,320	994	33%
Other Resources	1,460	1,673	-13%
Total Budgetary Resources	**$ 21,509**	**$ 21,501**	**0%**
Total Obligations Incurred	20,894	20,181	4%
Total Unobligated	**$ 615**	**$ 1,320**	**-53%**

New Budget Authority which represents eighty-seven percent of NASA's total budgetary resources during FY 2010, was provided by Congress primarily through two-year appropriations. In FY 2010, the Agency's appropriations increased by $941 million. NASA received $1,050 million of Recovery Act funding in fiscal year 2009 ($1,002 million Direct Appropriation and $48 million Reimbursable Authority), all of which has been obligated on projects to support the Nation's economic recovery and advance NASA's research mission. The Agency received an additional $4 million in Reimbursable Authority in FY 2010. NASA has completed all awards of Science, Exploration, Aeronautics, and Cross-Agency contracts and cooperative agreement proposals in accordance with applicable Program Plans and Recovery Act provisions, and almost seventy percent of funds appropriated have been disbursed for those projects. The Agency's progress on Recovery Act objectives is detailed in the table below. Details on NASA's progress are available at the following Web sites: *http://www.nasa.gov/recovery/index.html* and *http://www.nasa.gov/pdf/486292main_main_NASA_Weekly_and_Activity_Report_20100930.pdf*.

American Recovery and Reinvestment Act of 2009

(In Millions of Dollars)

Operation	Funding	ARRA Objectives	Obligations	Gross Outlays	Major Completed Actions
Science	$400	• To accelerate the development of the Tier 1 set of Earth Science climate research missions recommended by the National Academies Decadal Survey. • To increase the Agency's supercomputing capabilities.	$400	$309	$325 million of Recovery Act funds were applied to the Earth Science Program to conduct breakthrough research to advance fundamental knowledge on the most important scientific questions on the global and regional integrated Earth system. Activities encompass the global atmosphere; the global oceans including sea ice; land surfaces including snow and ice; ecosystems; and interactions between the atmosphere, oceans, land, and ecosystems. A balanced investment was made between all of the elements of the overall NASA Earth Science Program, including the spaceflight missions, technology development, research and analysis, and science applications. Recovery Act funds were used to accelerate the implementation of the recommendations of the National Research Council's Earth Science and Applications Decadal Survey (2007). This includes rapid deployment of a suite of Earth-observing satellites to leverage existing missions and provide cutting-edge measurements of key parameters relevant to climate change while preserving the balance discussed in the paragraph above. NASA also expended $75 million on the James Webb Space Telescope, within the Astrophysics Program, to maintain current workforce levels and increase the likelihood that it will launch on the planned date. Recovery Act funds were applied to spacecraft development activities including design and fabrication of key component systems. This important observatory will examine every phase of cosmic history: from the first luminous glows after the big bang to the formation of galaxies, stars, and planets to the evolution of our own solar system.
Exploration Systems	$400	• Fund planned mission development activities that could contribute to future exploration. • Stimulate efforts within the private sector to develop and demonstrate human spaceflight capability.	$400	$304	NASA invested $400M in Recovery Act funding for Exploration programs including the Constellation Systems Program, the Commercial Crew and Cargo Program, and the Dual Use Initiative. Each project had a uniquely identified scope of work to be completed during the FY 2009-2010 fiscal years. The Constellation Program used Recovery Act funds to supplement and enhance the planned scope of work efforts. NASA's Commercial Crew and Cargo Program (C3PO) invested financial and technical resources within the private sector to develop and demonstrate safe, reliable, and cost-effective space transportation capabilities to and from low Earth orbit (LEO). This investment of ARRA funds, allowed for the performance of risk reduction tasks for potential commercial crew capabilities. The Dual Use Initiatives used ARRA funds to accelerate development of a docking system to be used on the ISS, to enable dockings of various spacecraft vehicles. These funds also stimulated efforts within the private sector that will benefit dual use (government/commercial) launch site and test infrastructure, to provide long term benefits to the nation's launch vehicle development and services infrastructure.
Aeronautics Research	$150	• To undertake systems-level research, development and demonstration activities related to: - Aviation safety - Environmental impact mitigation - The Next Generation Air Transportation System (NextGen).	$150	$30	NASA invested $150 million of Recovery Act funds, into the existing Aeronautics Research Program, to enhance and expand the fidelity of current foundational research activities; ensure the availability of aeronautical test facilities; and conduct integrated system level research activities supporting NextGen. NASA's Aeronautics Research Program is comprised of four programs: Airspace Systems, Fundamental Aeronautics, Aviation Safety, and Aeronautics Test. Research in all programs was accelerated and enhanced through Recovery funds. Numerous awards were made across industry, academia and to non-profits to accelerate research in advanced aircraft technologies and systems, aircraft safety, fuel efficiency, and the Next Generation Air Transportation System. This research will lead to a safer, more environmentally friendly, and more efficient national air transportation system.

Operation	Funding	ARRA Objectives	Obligations	Gross Outlays	Major Completed Actions
Cross Agency Support	$50	• Reimbursable funds to meet different agency's Recovery Act objectives.	$50	$44	These funds addressed needed repairs of facilities important to NASA's human spaceflight missions, at the Johnson Space Center in Houston, Texas. Repairs were conducted on roofs on more than 20 buildings, exterior panels on 36 different buildings, and loggia ledges on 11 buildings. Added to these repairs, approximately 2360 windows, 100+ street/parking/sidewalk lights, and greater than 200,000 linear feet (nearly 40 miles!) of caulking was replaced. Over 1,000,000 sq ft (over 23 acres!) of building panels were cleaned and waterproofed. To complete this work, more than 85 percent of the new contracts were awarded to 8(a) companies.
Cross Agency Support	$52	• Reimbursable funds to meet different agency's Recovery Act objectives.	$52	$28	Other federal agencies, including the National Oceanic and Atmospheric Administration (NOAA) and the Department of Energy (DOE) provided NASA with reimbursable funds to meet the goals of their Recovery Act activities. Of note the NOAA-provided funds were awarded for development of climate sensors.
Inspector General	$2	• To provide oversight of NASA's implementation and execution of the Recovery Act and the requirements of the Office of Management and Budget's implementing guidance.	*	*	NASA's Office of Inspector General (OIG) continues to monitor the Agency's compliance with the accountability and transparency provisions of the Recovery Act and OMB's implementing guidance. To do this, the OIG has and continues to: 1) review NASA's processes for controlling Recovery Act funds and awarding associated agreements and contracts; and 2) review programs and projects funded under the Recovery Act to assess cost and schedule performance, achievement of key milestones, and compliance with OMB's implementing guidance. The OIG continues to identify new areas of review in an effort to increase its oversight of NASA's Recovery Act funding. During this period, the OIG conducted work at four field Centers and Headquarters and audited more than 40 contract actions and one cooperative agreement. Further, reviews were conducted of NASA's Recovery Act Agency and Program Plans to assess compliance with OMB implementation guidance, in addition to a review of NASA's open audit recommendations that could impact the Agency's successful implementation of the Recovery Act.
Total	**$1,054**		**$1,052**	**$715**	

*The Inspector General has amounts just below the displayable threshold of a million dollars.

Other Resources include funding received for sharing NASA technology and services provided to other Federal agencies and public entities, and recoveries of budgetary resources that were obligated in a previous year. Other Resources increased by one percent in FY 2010 primarily for work performed for other government agencies, such as the Department of the Air Force for TDRS, the National Oceanic and Atmospheric Administration (NOAA) for the Polar Operational Environmental Satellites (POES) and Geostationery Operational Environmental Satellite (GOES) projects.

Obligations Incurred represents NASA's use of $20.9 billion of available budgetary resources to accomplish the Agency's goals within its four R&D/Other initiatives. Obligations Incurred increased by four percent between FY 2010 and FY 2009.

Balance Sheet

Assets

Total assets as of September 30, 2010 were $18.3 billion, a decrease of $5.4 billion compared to September 30, 2009. NASA's assets are divided into four categories, as described in the table below.

NASA Assets
(In Millions of Dollars)

Line Item	Audited 2010	Unaudited 2009	% Change
Property, Plant & Equipment	$ 9,635	$ 11,577	-17%
Fund Balance with Treasury	8,601	8,854	-3%
Inventory	—	3,019	-100%
Other Assets	92	235	-61%
Total Assets	**$ 18,328**	**$ 23,685**	**-23%**

NASA's largest category of assets is **Property, Plant and Equipment** (PP&E), which decreased seventeen percent or $1.9 billion in FY 2010. This decrease is due to the completion of the Shuttle Program and a decrease in the Assets Under Construction (AUC) due to the ISS nearing completion.

Fund Balance with Treasury (FBWT) which represents NASA's cash balance at the Department of Treasury, decreased by three percent or $253 million. This change primarily represents net outlays that occurred during FY 2010 related to Recovery Act objectives.

Inventory and Related Property historically consists of operating materials and supplies (OM&S). During FY 2009, NASA utilized the consumption method of accounting for OM&S. However during FY 2010, the ISS construction and SS contracts were concluding. As a result, the OM&S related to these contracts, which comprised approximately eighty-eight percent of the balance, was decreasing. Given this fact as well as flexibility given to management by the Statement of Federal Financial Accounting Standard (SFFAS) No. 3, Accounting for Inventory and Related Property, management elected to adopt the purchases method of accounting which allows the expensing of OM&S.

Other Assets includes Investments of $18 million and Accounts Receivables of $71 million in FY 2010. Accounts Receivable decreased by $147 million due to the completion of work performed for the Department of the Air Force TDRS and Automatic Collision Avoidance Technology (ACAT) projects.

Liabilities

Total liabilities as of September 30, 2010 were $4.3 billion, an increase of $164 million compared to September 30, 2009. The major categories of liabilities are detailed in the table below.

NASA Liabilities
(In Millions of Dollars)

Line Item	Audited 2010	Unaudited 2009	% Change
Accounts Payable	$ 1,462	$ 1,384	6%
Other	1,755	1,786	-2%
Environmental and Disposal Liabilities	1,041	922	13%
Federal Employee and Veterans Benefits	55	57	-4%
Total Liabilities	**$ 4,313**	**$ 4,149**	**4%**

Accounts Payable represents amounts owed to other entities for goods and services received. Compared to the prior year, the FY 2010 balance increased by $78 million. This is due to an increase in obligations incurred during the year.

Other Liabilities represents estimated contractor costs incurred but not yet paid, as well as contingent liabilities for litigation claims, accrued payroll and related costs as well as NASA's liability for advances and prepayments, which remained consistent between the years.

Environmental and Disposal Liabilities are estimated cleanup costs for actual or anticipated contamination from waste disposal methods, leaks, spills, and other NASA activity that created, or could create, a public health or environmental risk, and cleanup costs associated with the removal, containment, and/or disposal of hazardous

wastes or material and/or property. In FY 2010, NASA recorded an additional $119 million dollars of environmental and disposal liabilities to reflect the estimated total cost of environmental cleanup on known hazardous conditions bringing the total to $1,041 million which includes anticipated cleanup at disposal for Space Shuttle and PP&E. The amount recorded in FY 2009 was $922 million. The increase is due to changes in individual project estimates and additional liabilities from disposal-related cleanup costs for PP&E.

Federal Employee and Veteran Benefits are amounts that the Department of Labor estimates on behalf of NASA for future worker's compensation liabilities for current employees. The estimate for future worker's compensation benefits includes the expected liability for death, disability, medical and miscellaneous costs for approved compensation cases, plus a component of incurred but not reported claims.

Net Position

Net Position represents the sum of Cumulative Results of Operations (CRO) and Unexpended Appropriations, which is the current value of NASA's assets less its liabilities. During FY 2010, NASA adopted a change in accounting principle which reduced the beginning balance of the CRO by $3.0 billion. This change in accounting principle, coupled with the reclassification of SS assets as well as Work-in-Process to expenses in FY 2010, caused Net Position to decrease by $5.5 billion during FY 2010.

NASA Net Position
(In Millions of Dollars)

Line Item	Audited 2010	Unaudited 2009	% Change
Unexpended Appropriations	$ 5,706	$ 6,128	-7%
Cumulative Results of Operations	8,309	13,408	-38%
Total Net Position	**$ 14,015**	**$ 19,536**	**-28%**

Systems, Controls, and Legal Compliance

Management Assurances

Administrator's Statement of Assurance

November 15, 2010

NASA management is responsible for establishing and maintaining effective internal controls and financial management systems that meet the objectives of the *Federal Managers' Financial Integrity Act* (FMFIA), as well as related laws and guidance. NASA is committed to a robust and comprehensive internal control program. We recognize that ensuring the effective, efficient, and responsible use of the resources that have been provided to the Agency is not only good stewardship, but also the right approach to maximizing our progress toward the realization of our goals. Within the Agency, I have made it clear that I am responsible for establishing and maintaining a sound system of internal control. In turn, I have made these responsibilities clear to my program management, mission support offices, and Center management—and they have communicated this responsibility to their subordinates. As a result, managers and employees throughout the Agency are active on a daily basis in identifying or updating key control objectives, assessing risks, implementing controls or other mitigating strategies, conducting reviews, and taking corrective actions as necessary.

I am very pleased to report that in FY 2010, the NASA Office of the Chief Financial Officer (OCFO) has implemented sufficient corrective actions to resolve the one remaining FY 2009 prior year material weakness—Asset Management: Valuing Legacy Property, Plant, and Equipment. OCFO's extensive work in collaboration with the Office of the Inspector General and the independent financial statement auditor confirmed that NASA's treatment of its legacy assets is in compliance with the Statements of Federal Financial Accounting Standards (SFFAS) 35, *Estimating the Historical Cost of General Property, Plant, and Equipment*. OCFO conducted extensive

analysis of its legacy assets and estimation methodology to demonstrate the validity of the approach in compliance with SFFAS 35. OCFO kept the Office of the Inspector General and independent financial statement auditors fully informed throughout FY 2010 and incorporated their input on planned activities to develop a reasonable valuation estimate for legacy assets. OCFO met the key objectives necessary for valuing legacy assets. As a result of NASA's efforts and the corrective actions taken, NASA concludes that the one remaining FY 2009 prior year material weakness is resolved.

NASA conducted its assessment of the effectiveness of internal controls over operations and compliance with applicable laws and regulations in accordance with OMB Circular A-123, *Management's Responsibility for Internal Control*. Based on the results of this evaluation, NASA can provide reasonable assurance that its internal controls over the effectiveness and efficiency of operations and compliance with applicable laws and regulations as of September 30, 2010, were operating effectively and no material weaknesses were found in the design or operation of the internal controls. NASA is also in conformance with Section 4 of FMFIA.

In addition, NASA conducted its assessment of the effectiveness of internal controls over financial reporting, which includes safeguarding of assets and compliance with applicable laws and regulations, in accordance with the requirements of OMB Circular A-123, Appendix A, *Internal Control over Financial Reporting*. OCFO follows a risk-based approach in determining the business cycles to be assessed during the current year. During FY 2010, the Property Management Cycle was reviewed. No new material weaknesses were identified as a result of the work performed. Based on the results of this evaluation, NASA makes an unqualified statement of assurance that its internal controls over financial reporting as of June 30, 2010, were operating effectively and no material weaknesses were found in the design or operation of the internal controls over financial reporting.

In accordance with the requirements of the Federal Financial Management Improvement Act (FFMIA), management is responsible for reporting on its implementation and maintenance of financial management systems that substantially comply with Federal financial management systems requirements, applicable Federal accounting standards, and the U.S. Government Standard General Ledger (SGL) at the transaction level. NASA's financial management systems are in substantial compliance with the requirements of FFMIA as of September 30, 2010.

As stated above, I am pleased that our one remaining FY 2009 prior year material weakness was resolved in FY 2010. In addition, NASA financial management systems are now in substantial compliance with FFMIA requirements. NASA will continue to work to ensure that its internal control program prevents new material weaknesses from developing.

Charles F. Bolden Jr.
Administrator

Photo previous page: Space Exploration Vehicle Rovers A and B are shown docked with the Habitat Demonstration Unit during the Desert RATS 2010 operations at Black Point Lava Flow, Arizona. (Credit: NASA)

The Government Accountability Office (GAO) High-Risk List

NASA has been on the GAO High-Risk List in the area of Contract Management since 1990, when the first High-Risk List was published. In the most recent GAO update to the High-Risk List, issued in January 2009, GAO changed the title of this High-Risk item from Contract Management to Acquisition Management, acknowledging the broad scope of issues being addressed. As of January 2009, GAO noted that NASA has made a concerted effort to improve and has made important advances, but added that it will take several years for the Agency to fully implement its High-Risk initiatives.

The NASA initiatives are identified in a comprehensive Corrective Action Plan that meets Office of Management and Budget (OMB) requirements. Successful implementation of both the plan and revised policies should stem cost growth and schedule slippage. Additional information is available at *http://www.nasa.gov/news/budget/index.html*.

Credit: NASA

This fall, NASA's Ames Research Center hosted an event for all ages to celebrate the 2010 International Observe the Moon Night. During the event, participants were able to view the Moon through telescopes set up by members of local amateur astronomy societies.

Looking Forward

The NASA Authorization Act of 2010, signed by the President on October 11, 2010, ended months of effort, negotiation, and debate to decide the direction of NASA's future. NASA now has a clear direction and can begin making plans for moving the Agency forward. There are still many details that the appropriations process will provide, but the broad guidelines are now in place. NASA is currently creating the Agency's next Strategic Plan, due to be unveiled in February 2011, which will articulate NASA's new Strategic Goals and direction. As part of this effort, NASA is also working to improve the Agency's performance management framework and how NASA measures and reports on performance throughout the organization.

This is a wonderful time for NASA—a time of excellent opportunities to shape a promising future for the Nation's space program. At the same time, an incredible amount of work lies ahead. In the broadest sense, NASA's biggest adjustments will be how to pursue the migration to commercial access to low Earth orbit, and place the U.S. space program on a more sustainable trajectory.

The Agency is excited at the prospect of developing multiple sources of access to space and opening up an entirely new segment of the American economy. Even though there are still many details to be completed, about the nature of NASA oversight and input in the commercial partnerships to be formed, NASA remains committed to making measured progress and not rushing into anything that does not ensure safety while achieving the Agency's goals.

President Obama has laid out an ambitious plan for NASA that pioneers new frontiers of innovation and discovery. The plan invests more in NASA; extends the life of the International Space Station; launches a commercial space transportation industry; fosters the development of ground-breaking technologies; and helps create

Photo above: NASA Astronaut Leland Melvin high-fives fifth- through 12th-graders at the Minority Student Education Forum. The forum was part of NASA's "Summer of Innovation" initiative and the Federal "Education to Innovate" campaign to increase the number of future scientists, mathematicians, and engineers. Early in FY 2011, Administrator Bolden named Melvin the new director of NASA's Office of Education. (Credit: NASA/C. Huston

thousands of new jobs. As NASA evaluates how to build on the legacy of the Space Shuttle and Constellation programs, the Agency will be striving to ensure that its skilled workforce has many opportunities to contribute to these future objectives. The talented and dedicated workforce that has helped to achieve so much over more than five decades will be crucial to the future, as well.

Detailed Performance

Measuring NASA's Performance

NASA creates an annual performance plan for each fiscal year to work toward achieving NASA's Strategic Goals. The performance plan includes multi-year Outcomes and Annual Performance Goals (APGs) under each Strategic Goal and Sub-goal included in NASA's Strategic Plan. This section provides detailed information on NASA's performance on the Agency's FY 2010 performance plan and the cost associated with those efforts.

NASA managers use both internal and external assessments to determine ratings for multi-year Outcomes and APGs. Internally, NASA monitors and analyzes each program's adherence to budgets, schedules, and key milestones. The managers provide these analyses during monthly or quarterly reviews at the Center, Mission Directorate, and Agency levels to communicate the health and performance of their programs and projects. Based on the ratings, the managers formulate appropriate follow-up actions.

External advisors, like the NASA Advisory Council, the National Research Council, and the Aerospace Safety Advisory Panel, assess program content and direction. Also, experts from the science community, coordinated by NASA's Science Mission Directorate, review the Agency's progress toward meeting performance measures under Sub-goals 3A through 3D.

Many of the programs and projects mentioned in NASA's performance measures are either robotic or human spaceflight missions. For more information on the missions mentioned in the PAR, please see *NASA's Missions at a Glance*, located in the Other Accompanying Information section of this document.

A Reader's Guide to NASA's Detailed Performance Data

NASA's detailed performance data is organized by the Strategic Goals and Sub-goals. Each Strategic Goal and Sub-goal contains the following information.

Summary of Performance

Each Strategic Goal or Sub-goal section presents a summary of performance ratings for the multi-year Outcomes and APGs that support the goal. It also provides the expenditures associated with those activities.

Benefits

This narrative explains the value of work toward the Strategic Goal or Sub-goal, from gains within the Agency to benefits for academia, the public sector, and government.

Risks

Risk assessments are a regular part of NASA's review process. In this portion, NASA outlines and describes the primary concerns facing management with respect to cost, schedule, technical, or programmatic issues as they may affect individual missions, programs, or the Agency as a whole.

Image above: On August 30, 2010, the Geostationary Operational Environmental Satellite 13 (GOES-13) captured this image of Hurricane Danielle heading for the north Atlantic (top center), Hurricane Earl with a visible eye hitting the Leeward Islands (left bottom), and a developing tropical depression (lower right edge). (Credit: NASA/NOAA GOES Project)

Performance Measure Descriptions, Ratings, and Trends

Each Outcome is a multi-year performance target designed to support the overarching Strategic Goal or Sub-goal. The description explains the activities completed in FY 2010 to meet the Outcome. NASA assigns ratings to these Outcomes on a yearly basis, and provides the current rating along with previous years' ratings to show trends in performance. While NASA rates the Outcome on a yearly basis, the rating takes into account past performance and future work. Management uses the scale below to assign ratings to the Outcomes based on their internal and external assessment results.

Every APG supports a multi-year Outcome. Although the APG is annual, it may be repeated several years in a row. NASA assigns ratings to these APGs on a yearly basis, and provides the current rating along with previous years' ratings to show trends in performance. In some cases, an APG may support more than one Outcome, and will be shown multiple times. Management uses the scale below to assign ratings to APGs based on their internal and external assessment results.

For any unmet performance measure in FY 2010, NASA managers are responsible for providing a reason for not achieving the measure and plans for reaching the measure in the future. The FY 2011 PAR will include an update to this year's Performance Improvement Plans, explaining activities and decisions that satisfy the plan set forth in FY 2010.

What do the color ratings mean?		
Color	**Multi-year Outcome Rating**	**Annual Performance Goal Rating**
Green	NASA achieved most APGs under this Outcome and is on-track to achieve or exceed this Outcome.	NASA achieved this APG.
Yellow	NASA made significant progress toward this Outcome, however, the Agency may not achieve this Outcome as stated.	NASA failed to achieve this APG, but made significant progress and anticipates achieving it during the next fiscal year.
Red	NASA failed to achieve most of the APGs under this Outcome and does not expect to achieve this Outcome as stated.	NASA failed to achieve this APG and does not anticipate completing it within the next fiscal year.
White	This Outcome was canceled by management directive or is no longer applicable based on management changes to the APGs.	This APG was canceled by management directive and NASA is no longer pursuing activities relevant to this APG, or the program did not have activities relevant to the APG during the fiscal year.

Trending Information

If an APG is new in FY 2010, there will be no previous ratings available. The table below explains other trending information.

None	Although NASA may have conducted work in this area, management did not include a performance measure for this work in the fiscal year's performance plan.
7ES11 Green **7ES12 Green**	In prior years where data is available, NASA notes the applicable Outcome or APG reference number and rating to provide performance trends. In some cases, an APG may track to more than one performance measure in past performance years.

Additional Information

Uniform and Efficiency Measures

NASA uses Uniform and Efficiency Measures to track the performance of management areas such as cost, schedule, and project completion. A table provides these measures, with current and previous ratings for trending, organized by NASA's budget Themes.

FY 2009 Performance Plan Update

The FY 2009 Performance Improvement Plan Update reports activities and progress achieved during FY 2010 to resolve unmet measures from FY 2009.

Strategic Goal 1

Fly the Shuttle as safety as possible until its retirement, not later than 2010.

Summary of Ratings for Strategic Goal 1	
2 Outcomes	5 APGs
Green = 1	Green = 3
Yellow = 1	Yellow = 2
Red = 0	Red = 0
White = 0	White = 0

FY 2010 Cost of Performance (Dollars in Millions)
$4,678.5

The Space Shuttle has supported NASA's Mission for nearly 30 years, carrying crew and cargo to low Earth orbit, performing repair, recovery, and maintenance missions on orbiting satellites, providing a platform for conducting science experiments, and supporting construction of the International Space Station (ISS).

NASA has pushed back the planned retirement date for the Space Shuttle fleet until FY 2011 in order to ensure the completion of ISS. Until then, the Agency will demonstrate NASA's most critical value, safety, by promoting engineering excellence, maintaining realistic flight schedules, and fostering internal forums where mission risks and benefits can be discussed and analyzed freely.

Benefits

The Space Shuttle is recognized around the world as a symbol of America's space program, and the Nation's commitment to space exploration. NASA's Space Shuttle Program has inspired generations to pursue dreams and careers in science, technology, engineering, and mathematics. The program directly benefits the Nation by advancing national security and economic interests in space and by spurring technology development in critical areas such as navigation, computing, materials, and communications.

Risks to Achieving Strategic Goal 1

The Space Shuttle Program faces two main challenges. First, NASA must maintain the skilled workforce and critical assets needed to safely complete the Space Shuttle manifest. Second, NASA must manage the process of retiring the Shuttle and transitioning or disposing of Space Shuttle assets and capabilities when they are no longer needed for safe mission execution of the Shuttle or for other Agency use. Because of the size, complexity, and geographic dispersion of the program's assets, transition and retirement has required careful planning so as to not interfere with safe mission execution and with minimal impact to other Agency activities.

In addition to the sheer size of asset disposition activities, the Agency must cost-effectively manage and protect the Space Shuttle capabilities needed to satisfy the Agency's goal of flying out the manifest and completing assembly of the ISS. The program also plays a key role in coordinating the smooth transition from current Space Shuttle operations to the next generation of exploration activities, thereby enabling new U.S. human spaceflight capabilities that will extend exploration and permanent human presence beyond low Earth orbit.

Photo above: Space Shuttle *Atlantis* (STS-132) launches in a plume of smoke from NASA Kennedy Space Center on May 14, 2010. On its last planned flight, *Atlantis* delivered to the ISS the Russian-built Mini Research Module-1, which will provide additional storage space and a new docking port for Russian Soyuz and Progress spacecraft. (Credit: NASA/S. Joseph and K. O'Connell)

Outcome 1.1: Assure the safety and integrity of the Space Shuttle workforce, systems and processes, while flying the manifest.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA

On July 8, 2010, a crowd follows External Tank 138 as it leaves the Michoud Assembly Facility in New Orleans and begins its trip to the Kennedy Space Center in Florida. The last Space Shuttle tank produced at the facility, it is destined to support the STS-134 (*Endeavour*) launch. The day featured an event to commemorate 37 years of successful tank deliveries, as well as the final external tank's rollout.

Space Shuttle flies four successful missions to the International Space Station

The Space Shuttle Program successfully completed all mission objectives in FY 2010. NASA safely carried out four assembly and logistics flights to ISS; significantly enhancing the facilities and capabilities of the ISS. In preparation for Space Shuttle retirement, Space Shuttle *Atlantis* completed its last planned mission in May 2010 after delivering a new Russian module, batteries and other equipment and supplies to the ISS. During its lifetime, *Atlantis* flew 32 missions and traveled a total of more than 120 million miles.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Achieve zero Type-A (damage to property at least $1 million or death) or Type-B (damage to property at least $250 thousand or permanent disability or hospitalization of three or more persons) mishaps in FY 2010.	7SSP1 Green	8SSP01 Green	9SSP1 Green	10SSP01 Green
Complete 100% of all mission objectives for all Space Shuttle missions in FY 2010 as specified in the Flight Requirements Document for each mission.	7SSP2 Green	8SSP02 Green	9SSP2 Green	10SSP02 Green

Outcome 1.2: By December 31, 2010, retire the Space Shuttle.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Yellow

Credit: NASA/J. Pfaller

This long-range view shows equipment at the Kennedy Space Center's Launch Pad 39B dismantling the rotating service structure (RSS). Crews put sand, reinforcing steel, and large wooden mats under the RSS to protect the structure's concrete from falling debris during deconstruction. Starting in 2009, the structure at the pad was no longer needed for NASA's Space Shuttle Program, so it is being restructured for future use.

NASA prepares for Space Shuttle retirement

In FY 2010, NASA continued to prepare for the final Space Shuttle flights in November 2010 and February 2011 by producing and delivering major Space Shuttle hardware elements, including the last Solid Rocket Boosters and External Tanks. NASA also completed the Shuttle Transition Property Assessment to identify Space Shuttle assets that could still be used by the Agency in the future and to transfer assets no longer needed by NASA to interested organizations like museums and universities. As the Space Shuttle fleet approaches retirement, the Agency is directing available Space Shuttle personnel, assets, and knowledge toward the development and support of new hardware, technologies, and capabilities for human space exploration.

Why NASA is not on track to achieve Outcome 1.2 as stated: The yellow rating for Outcome 1.2 reflects an adjusted mission schedule that postpones Shuttle retirement activities in response to an Administration policy decision to extend Shuttle flights beyond 2010 to support the completion of the International Space Station.

Plans for achieving Outcome 1.2: Based on the extended mission schedule, NASA plans to retire the Space Shuttle in 2011.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Complete close-out and transfer plans for all remaining Space Shuttle flight hardware elements and other major Space Shuttle property assets, including the disposition plans for the Orbiters and the means by which significant gaps in human spaceflight operations capabilities will be managed if needed to support future activities.	None	None	None	10SSP03 Yellow
Complete 100% of the Transition Property Assessment for Space Shuttle Program property by no later than the second quarter of FY 2010.	None	None	None	10SSP04 Green
With the Constellation Program, complete and deliver one workforce transition strategy report update to Congress in FY 2010.	None	None	None	10SSP05 Yellow

Why NASA did not achieve APG 10SSP03: The Agency's decision to extend Space Shuttle flights into 2011 and the uncertainty regarding the future of the Constellation Program caused a delay in finalizing Shuttle asset disposition plans and resolving the human spaceflight gap.

Plans for achieving 10SSP03: Disposition plans for the Orbiters will be completed once NASA announces final display locations. NASA plans to resolve funding gaps for human spaceflight capabilities through the FY 2012 budget development process.

Why NASA did not achieve APG 10SSP05: Development of Workforce Transition Strategy reports has been rescheduled pending direction to the Agency following the release of the FY 2011 President's Budget Submit, the proposed transition of the Constellation Program, and identification of future work. In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010.

Plans for achieving 10SSP05: The plan is pending decision of the proposed transition of the Constellation Program.

Strategic Goal 2

Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.

Summary of Ratings for Strategic Goal 2	
3 Outcomes	10 APGs
Green = 3	Green = 9
Yellow = 0	Yellow = 1
Red = 0	Red = 0
White = 0	White = 0

FY 2010 Cost of Performance (Dollars in Millions)
$3,711.3

Built and operated using state-of-the-art science and technology, the International Space Station (ISS) remains a vital aspect of NASA and its program of exploration. As of September 2010, there have been over a hundred flights to the ISS, including flights for assembly, crew rotation, and logistical support. When assembly is complete in 2011, the ISS will be composed of approximately one million pounds of hardware brought to orbit over the course of more than a decade.

Benefits

The ISS, the largest crewed spacecraft ever built, provides an environment for developing, testing, and validating next generation technologies and processes, which are needed to support NASA's plans to send human explorers deeper into space. The ISS is a test bed for exploration technology and process experiments, and provides opportunities for research in fundamental physics, biology, materials sciences, and medicine. Its equipment and location provide a unique platform for Earth observations, microgravity research, and investigations into the long-term effects of the space environment on human beings. Crewmembers test processes for repairing equipment in microgravity, conducting spacewalks, and keeping systems operational over long periods of time. These capabilities are critical to future missions beyond low Earth orbit.

The ISS Program represents an unprecedented level of international cooperation with many nations providing the resources and technologies to build and keep the ISS operational. These international partnerships have increased cooperation and goodwill among participating nations and will continue to serve as a model for future space cooperation.

Risks to Achieving Strategic Goal 2

Strategic Goal 2 has two primary risks: the Space Shuttle Program's ability to carry out the ISS manifest and complete assembly operations, and the continued operation of the systems that support the six-person crew capability.

Photo above: An STS-132 crewmember aboard *Atlantis* took this photograph of the ISS on May 23, 2010, as the Space Shuttle undocked and began separation on its return to Earth. (Credit: NASA)

Outcome 2.1: By 2010, complete assembly of the U.S. On-orbit Segment; launch International Partner elements and sparing items required to be launched by the Shuttle; and provide on-orbit resources for research to support U.S. human space exploration.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA

In February 2010, Kathryn Hire, STS-130 mission specialist, works in the newly-installed ISS Cupola. The Space Shuttle crewmembers helped install the Cupola, a European Space Agency-provided module that will provide clear views of activities outside the ISS and spectacular views of Earth.

ISS construction nearing completion

While NASA was unable to launch every piece of hardware planned for the ISS in FY 2010, a Russian research module and EXpedite the PRocessing of Experiments to the Space Station (ExPRESS) Logistics Carriers (ELC) were launched. Delays in the Shuttle missions driven by technical issues with the Alpha Magnetic Spectrometer (AMS) experiment caused delays in the launch of the two remaining ELCs, AMS, and the Permanent Multipurpose Module (PMM). The payloads are now scheduled to be launched during the first half of FY 2011.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Based on the actual Space Shuttle flight rate, number of remaining Shuttle flights, and the discussions with the International Partners, update the agreed-to ISS assembly sequence and transportation plan as necessary.	7ISS1 Green	8ISS01 Green	9ISS1 Green	10ISS01 Green
Accomplish a minimum of 90% of the on-orbit research objectives as established one month prior to a given increment.	7ISS2 Green	8ISS02 Green	9ISS2 Green	10ISS02 Green
Per the final configuration agreed to by the International Partners, fly the ISS elements and logistics baselined for FY 2010.	7ISS3 Green	8ISS03 Green	9ISS3 Green	10ISS03 Yellow
Provide increased ISS capability and utilization by integrating ISS elements, payloads, and spares including the EXPRESS Logistics Carriers 1 through 4, Cupola, Node 3, Multipurpose Pressurized Logistics Module, a COTS demonstration, and Mini-Research Module.	None	8ISS04 Green	9ISS4 Yellow	10ISS04 Green

Why NASA did not achieve APG 10ISS03: Due to technical difficulties and unforeseen delays, NASA was unable to fly all ISS elements and logistics planned for FY 2010.

Plans for achieving 10ISS03: Consistent with an Administration policy decision, NASA has revised the Shuttle manifest and related logistics to accommodate the delays experienced in FY 2010 and anticipates ISS completion in FY 2011.

Outcome 2.2: Through 2015, provide the on-orbit capability to support an ISS crew of 6 crewmembers.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA

Tracy Caldwell Dyson, Expedition 23 flight engineer, poses for a photo while holding Power and Data Grapple Fixture (PDGF) hardware in the ISS Harmony node. PDGFs allow the robotic manipulator arm Canadarm2 to attach, pick up, manipulate, and detach from various locations around the exterior of the ISS.

A bigger station, a bigger crew

NASA fully met the goal of providing support for a crew of 6 during FY 2010 as crewmembers from Expeditions 19 through 25 rotated to and from the ISS. NASA also worked with its International Partners and commercial cargo suppliers to develop plans for maintaining a crew of 6 on ISS through at least 2015. This will be accomplished with a combination of U.S. commercial, Russian, European, and Japanese logistics missions.

NASA fully met the goal of providing support for a six-passenger crew during FY 2010 as crewmembers from Expeditions 19 through 25 rotated to and from the ISS.

Expeditions 23 and 24 finished the laboratory, delivering additional facilities to enable full use of the International Space Station for research, technology development, and education. With nearly 130 integrated investigations involving the work of nearly 400 scientists around the globe; scientific throughput has quadrupled during the transition from ISS assembly to the era of utilization.

NASA also worked with its international partners and commercial cargo suppliers to develop plans for maintaining a six-passenger crew on ISS through at least 2015. This will be accomplished with a combination of U.S. commercial, Russian, European, and Japanese logistics missions.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Achieve zero Type-A (damage to property at least $1 million or death) or Type-B (damage to property at least $250 thousand or permanent disability or hospitalization of three or more persons) mishaps in FY 2010.	None	None	None	10ISS05 Green
In concert with the International Partners, maintain a continuous crew presence on the ISS by coordinating and managing resources, logistics, systems, and operational procedures.	7ISS5 Green	8ISS06 Green	9ISS6 Green	10ISS07 Green
Deliver 100% of planned on-orbit resources (including power, data, crew time, logistics, and accommodations) available to support research.	None	None	None	10ISS08 Green

Outcome 2.3: Conduct basic and applied biological and physical research to advance and sustain U.S. scientific expertise.

FY07	FY08	FY09	FY 2010
None	Green	Green	Green

Credit: NASA

Expedition 23 flight engineer T.J. Creamer poses for a photo next to the Microgravity Science Glovebox, an enclosed facility used to conduct experiments that are messy or potentially hazardous. The astronauts use it to conduct most of the fluid dynamics and flame experiments.

NASA space experiments working to improve life on Earth

In FY 2010, NASA completed and launched new experimental facilities for the International Space Station (ISS) and used ISS facilities and the Space Shuttle to conduct numerous scientific investigations focused on the fundamental laws governing natural processes while also enhancing the knowledge required to prepare NASA for future space missions. Some of the scientific investigations conducted in support of this Outcome include:

- The Capillary Channel Flow experiment (CCF): This experiment examined the limitations of fluid dynamics in space and will help researchers improve a wide range of spacecraft fluid systems.
- The Dynamic Selection of Interface Patterns (DSIP): This experiment focused on the dynamics that lead to uniform, reproducible three-dimensional pattern formation during the solidification of alloys. Understanding these dynamics could improve many industrial applications that rely on pattern formation for controlling microstructure in high temperature, high strength alloys.
- The Gravitational Effects on Biofilm Formation During Space Flight (Micro-2) experiment examined how gravity alters biofilm (an aggregation of microorganisms) formation with the goal of developing new strategies to reduce their impact on crew health and to minimize the harmful effects of biofilms on materials in space and on Earth.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Deliver 2 out of 3 of the following exploration technology payloads to SOMD for launch to the ISS: 1) Boiling Experiment Facility; 2) Capillary Channel Flow, or several test vessels of the Capillary Flow Experiment-2; or 3) Conduct the tests for the Flame Extinguishment Experiment exploration payload on ISS.	None	8AC01 Green	9AC1 Green	10AC01 Green
Conduct 3 out of 4 of the following nonexploration experiments on the ISS: 1) Dynamical Selection of Interface Patterns; 2) Two samples from Microstructure Formation in Castings of Technical Alloys under Diffusive and Magnetically-Controlled Convective Conditions (MICAST)/Columnar-Equiaxed Transition in Solidification Processing experiment; 3) Binary Critical Aggregation Test-5; or 4) Investigating the Structures of Paramagnetic Aggregates from Colloidal Emulsions-3.	None	None	9AC2 Green	10AC02 Green
Develop for flight two ISS/Shuttle/Free Flyer payloads: Develop the Animal Enclosure Module for launch on the Space Shuttle, to conduct immunology research on rodents; and develop a nano-satellite as a secondary Free Flyer payload to conduct fundamental biological research.	None	None	None	10AC03 Green

Sub-Goal 3A

Study Earth from space to advance scientific understanding and meet societal needs.

Summary of Ratings for Sub-Goal 3A	
7 Outcomes	17 APGs
Green = 7	Green = 14
Yellow = 0	Yellow = 3
Red = 0	Red = 0
White = 0	White = 0

FY 2010 Cost of Performance (Dollars in Millions)
$2,133.6

NASA has pursued its unique mission in Earth science, which is to expand human knowledge of Earth through space activities. This mission is specifically mandated by NASA's establishing legislation, the National Aeronautics and Space Act of 1958. Indeed, half a century of progress in spaceflight and advances in space-related technology have steadily changed the perception of Earth. Global satellite measurements of key characteristics have given rise to a profound new understanding of Earth as a system of interconnected parts.

NASA pioneered what is now called Earth System Science. From the vantage point of space, NASA currently focuses on studying atmospheric composition, weather, climate variability and change, water and energy cycles, carbon cycle and ecosystems, and Earth surface and interior. Over the past 50 years, the world's population has doubled, world grain supplies tripled, and total economic output grew sevenfold. NASA now observes that expanding human activities affect half the entire land surface of Earth and are altering world atmospheric composition, oceans, ecosystems, and ice masses.

NASA has also observed how international agreements can begin to reverse some of those trends, as in the case of industrially produced chlorofluorocarbons. By understanding these varying processes and their interaction, scientists can make predictions about the Earth system, quantitatively test those theories against satellite observations, and eventually improve forecasting in order to better inform resource management decisions and policies of governments at all levels.

Thus, fundamentally this Sub-goal answers the question: How is Earth changing and what are the consequences for life on Earth? In January 2007, the National Research Council (NRC) released its first Earth science decadal survey, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (available online at *http://www.nap.edu/catalog.php?record_id=11820*). This decadal survey describes Earth science as one of the greatest intellectual challenges facing humanity and outlines a program of scientific discovery and development of applications that will enhance economic competitiveness, protect life and property, and assist in the stewardship of the planet for this and future generations. NASA has embarked on the implementation of the Decadal Survey recommendations, while continuing its critical contributions to national programs and interagency

Image above: Arctic sea ice and seasonal land cover change are shown on March 30, 2010, the day before sea ice reached its 2010 maximum extent. Sea ice coverage over the Arctic Ocean oscillates over the course of a year, growing through winter and reaching a maximum extent by February or March. This year, Arctic sea ice grew to levels beyond those measured in recent years but slightly below average when compared to the 30-year satellite record. (Credit: NASA/Goddard Space Flight Center Scientific Visualization Studio)

collaborations. For example, the NASA Earth Science Program is the largest contributor to the congressionally mandated U.S. Global Change Research Program (USGCRP).

Benefits

Much of the science community's present state of knowledge about global change, including many of the measurements and a significant fraction of the analyses that serve as the foundation for the assessment reports of the Intergovernmental Panel on Climate Change (IPCC) and the quadrennial ozone assessment by the World Meteorological Organization, is derived from NASA's Earth Science Program. For example, using data from Earth observing satellites, NASA-supported researchers are: discovering the rapidity of sea ice depletion in the Arctic cover and ice sheet motions in the Arctic and Antarctic; quantifying short-term and long-term changes to Earth's protective shield of stratospheric ozone, including the positive impacts of the Montreal Protocol; establishing relationships between increasing upper ocean temperature and decreasing primary production from the phytoplankton that form the base of the oceans' food chain; using a fleet of satellites flying in formation (the A-Train) to study the effects of aerosols in the atmosphere on cloud formation and cloud cover; and using rainfall, vegetation, and other data to help predict food shortage conditions in developing countries.

By flying satellites in the A-Train formation, NASA is capable of making unique, global, near-simultaneous measurements of aerosols, clouds, temperature and relative humidity profiles, and radiative fluxes. Similarly, the use of satellites, aircraft, and ground-based monitoring stations provides NASA effective calibration of new measuring capabilities and provides unprecedented views into numerous phenomenon, such as the origin of storms. This vital research conducted by NASA and its partners, other government agencies, academia, non-profit organizations, industry, and international organizations helps the Nation manage environmental and agricultural resources and prepare for natural disasters. With its operational partners, NASA applies the resulting data and knowledge with the Agency's operational partners to improve their decision-making in societal need areas such as public health, aviation, water management, air quality, and energy.

NASA's Earth Science Program also supports the development of new sensors and instruments, advanced communications systems, and computer technologies.

Near-real-time measurements from NASA research missions, such as the Tropical Rainfall Mapping Mission (TRMM), the Quick Scatterometer (QuikSCAT), and the Atmospheric Infrared Sounder instrument on the Aqua mission are used routinely by the National Oceanic and Atmospheric Administration (NOAA) and other U.S. and international agencies to improve weather forecasting. NASA works closely with NOAA and the other Federal agencies to transition satellite research measurement capabilities to long-term operations, as appropriate.

Risks to Achieving Sub-goal 3A

The Earth Science Division, along with NASA's other Science divisions, continues to be concerned with the increased cost and the reduced availability of expendable launch vehicle (ELV) options. Over the course of the last decade, the Delta II has been the workhorse for launching many robotic mid-sized spacecraft. Without this option, NASA has access only to costlier evolved ELVs (Delta IV, Atlas V), which were designed to launch payloads larger than planned for many of the Earth Science missions identified in the NASA Science Plan. Possible cost growth in the evolved ELV class is an additional source of concern. These problems cannot be avoided until new commercial launch vehicles become available, potentially reducing the cost of launching missions.

Outcome 3A.1: Progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

NASA watches an Icelandic giant awaken

On March 20, 2010, Iceland's Eyjafjallajökull volcano (pronounced "Aya-fyatla-jo-kutl") awakened for the first time in 120 years, and NASA's Earth observing satellites were watching and collecting data.

Through its fleet of satellite assets, NASA is able to rapidly generate and broadly disseminate imagery and data products on the location, heights, and densities of ash plumes and related hazards. NASA demonstrated reliable and accurate detection of volcanic ash clouds using observations of sulfur dioxide (SO_2) from the Ozone Monitoring Instrument (OMI) onboard the NASA Aura satellite.

Credit: NASA/MODIS Rapid Response Team

Iceland's Eyjafjallajokull volcano was still streaming ash as NASA's Aqua satellite flew overhead on May 9. Iceland and the volcano are located in the top left part of this satellite image, with the ash and steam trailing a brown plume as it blew in a south-southeast direction over the Atlantic Ocean. The ash was estimated at heights of 30,000 feet. The brighter white color is snow and ice on Iceland's land surface. This and other images of Iceland's volcano are available at: *http://www.nasa.gov/topics/earth/features/iceland-volcano-plume-archive1.html*.

Sulfur dioxide is a reliable marker for fresh ash clouds from explosive magmatic eruptions, as it provides a clear discrimination between volcanic plume and ordinary clouds. Since volcanic eruptions are essentially the only large sources of stratospheric SO_2, false alarms are non-existent. Satellite observations of SO_2 thus assist operational agencies to identify and locate volcanic ash clouds, in particular during the first few days after an eruption. In general, the ash in a volcanic plume will drop due to gravity effects faster than the SO_2, so that some distance away from the volcano the ash and SO_2 clouds may be separated.

By the end of May, considerable steam had been coming from the crater, but monitoring the eruption became difficult because of windblown ash. NASA provided atmospheric composition data, including ash plume height and optical depth maps from The Earth Observing System (EOS) Multi-angle Imaging SpectroRadiometer (MISR) and Moderate Resolution Imaging Spectroradiometer (MODIS) instruments, respectively, to the international advisory groups that feed scientific input to the European operational Volcanic Ash Advisory Center. The MISR and MODIS, which were capable of detecting fires and the heat of lava flows, often were the only way to track the eruptions. The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite recorded a vertical profile of the atmosphere, which revealed the altitude of the ash clouds. NASA, in collaboration with NOAA, provides information on volcanic SO_2 and ash aerosols from OMI every three hours after the data is acquired. This information is used to supplement data from NOAA's Operational Environmental Satellites. NOAA distributes these data online to its Volcanic Ash Advisory Centers (VAACs).

At the time of the latest eruption, SO_2 information was being made routinely available only for sectors covering the Americas and the Pacific, through the Anchorage and Washington Volcanic Ash Advisory Centers (VAACs). However, beginning on April 19, 2010, NASA began to provide this information for sectors covering Iceland and

Northwest Europe to the VAAC in London. This information is now being utilized in the formulation and validation of Volcanic Ash Advisories over Europe. These observations helped modelers in volcanic ash advisory centers improve forecasting models and issue more accurate warnings to pilots and others with aviation interests.

Global Hawk takes flight for atmospheric science

NASA and colleagues from the National Oceanic and Atmospheric Administration completed the first science campaign with the new NASA Global Hawk Unmanned Aircraft System. This campaign obtained over 100 hours of both in situ and remote sensing observations in the upper troposphere and lower stratosphere over the Pacific Ocean, Alaska, and Arctic Ocean. The flights directly sampled and measured greenhouse gases, ozone-depleting substances, aerosols, and constituents of air quality.

For more information on the Global Hawk Pacific campaign go to *http://www.nasa.gov/centers/dryden/research/GloPac/index.html*.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Demonstrate progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition (based on measurements from presently orbiting NASA and non-NASA assets). Progress will be evaluated by external expert review.	7ESS1 Green	8ES01 Green	9ES1 Green	10ES01 Green
Conduct the flight program in support of this Outcome, as demonstrated by achieving mission success criteria for Aura.	None	None	None	10ES03 Green
Develop missions in support of this Outcome, as demonstrated by completing the Pre-Ship Comprehensive Performance Test for Glory.	7ESS8 Yellow	8ES09 Yellow	9ES3 Red	10ES21 Yellow
Develop missions in support of this Outcome, as demonstrated by conducting the acquisition strategy meeting for the OCO-2 mission, defining the implementation and acquisition approach for the reconstituted mission.	7ESS6 Yellow	8ES04 Yellow	9ES2 Green	10ES22 Green

Why NASA did not achieve APG 10ES21: The Glory Pre-Ship Comprehensive Performance Test began on September 17, 2010, but was not completed until October 4, 2010. The test was delayed primarily due to resolution of spacecraft hardware anomalies.

Plans for achieving 10ES21: The test was completed successfully on October 4, 2010.

Outcome 3A.2: Progress in enabling improved predictive capability for weather and extreme weather events.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

NASA puts the power of information in users' hands

With its partners at NOAA weather forecast offices, NASA provides measurements from the Atmospheric Infrared Sounder (AIRS), Cloudsat/CALIPSO, Moderate Resolution Imaging Spectroradiometer (MODIS) and Advanced Microwave Scanning Radiometer–Earth Observing System (AMSR-E) to improve the skills of operational weather forecasts. Through the Short-term Prediction Research and Transition (SPoRT) center, NASA satellite observations are used by 15 National Weather Service (NWS) Weather Forecast Offices (WFOs) for severe weather forecasting.

SPoRT was established in 2002 to demonstrate the weather and forecasting application of real-time EOS measurements from NASA climate monitoring sensors. It has grown to be an end-to-end research to operations activity focused on the use of advanced NASA modeling and data assimilation techniques, now-casting, and unique high-resolution multispectral observational data to improve short-term weather forecasts. SPoRT provides a suite of over 30 products, unique weather forecasts, and weather analyses to 15 NWS forecast offices in the southeast U.S. The offices use the products to improve situational awareness leading to better forecasts and warnings.

Credit: NASA/J. Schmaltz, MODIS Land Rapid Response Team

A cloudless day in the central United States shows the colors characteristic of fall on October 5, 2010, when MODIS aboard the Aqua satellite passed overhead. Another feature often seen in fall are the numerous fires, visible from the thin line of smoke along the left side of the photo from fires burning along the lower Mississippi River valley. Fall is harvest time in this agricultural area, and the vegetation becomes dry and flammable. SPoRT is helping forecasters use MODIS to monitor fires and other hazards.

Recent activities have shown that the assimilation of AIRS radiance and profile data on a regional scale can provide consistent improvement in understanding the thermodynamic structure of the atmosphere in data void regions, leading to better short-term weather forecasts. A high resolution sea surface temperature composite product derived from MODIS and AMSR-E data has been demonstrated to make improvements in the prediction of coastal weather processes and tropical weather systems. The use of NASA observations to better model surface conditions (e.g., fluxes of heat and moisture) in the NASA Land Information System (LIS) has produced better regional weather forecasts. NASA data sets and advanced research capabilities are currently used by collaborating forecast offices and the broader weather community via the Weather and Research Forecast (WRF) Environmental Modeling System. Forecasters also benefit directly from real-time observations of low clouds and fog, snow cover imagery, sea surface temperatures, land surface temperatures, wildfire hot spots maps, and other unique NASA imagery and products covering regions void of more conventional data.

For more on SPoRT go to *http://weather.msfc.nasa.gov/sport/*.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Demonstrate progress in enabling improved predictive capability for weather and extreme weather events. Progress will be evaluated by external expert review.	7ESS2 Green	8ES02 Green	9ES7 Green	10ES04 Green
Develop missions in support of this Outcome, as demonstrated by completing the Global Precipitation Measurement (GPM) Critical Design Review (CDR).	None	8ES06 Yellow	9ES8 Yellow	10ES06 Green

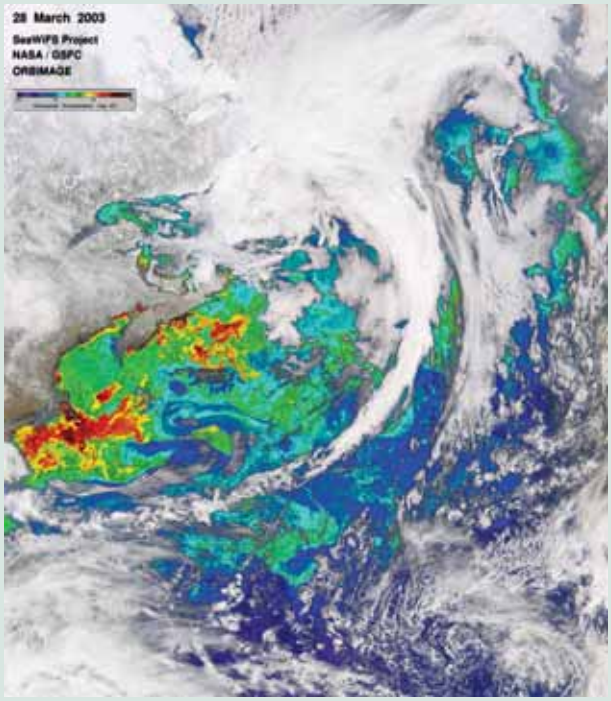
Outcome 3A.3: Progress in quantifying global land cover change and terrestrial and marine productivity, and in improving carbon cycle and ecosystem models.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

NASA monitors microscopic ocean plants from orbit

Around the globe, plants are the base of the food web. In the oceans, phytoplankton (microscopic plants) grow in the sunlit surface waters. Places where blooms are frequent often support thriving marine life. In FY 2010, scientists concluded that global ocean phytoplankton production can only be discerned in the satellite record with continued, long-term data collection.

The spring phytoplankton bloom is one of the most widespread changes in the oceanic biosphere, beginning just north of the Sargasso Sea and Bermuda and spreading northward toward Iceland. The best way to view this bloom is from space, using instruments that can discern the subtle changes in bloom color and concentration.



Credit: NASA/ORBIMAGE

The red and yellow colors in this image represent high chlorophyll concentrations in the sea's surface waters off the northeastern coast of Canada. Chlorophyll is a primary pigment found in phytoplankton. The green hues show moderately high chlorophyll concentrations, and blues represent low values. This image was produced using Sea-viewing Wide Field-of-view Sensor (SeaWiFS) data collected on March 28, 2003.

Phytoplankton influence global climate by regulating gases in the atmosphere. Like all plants, phytoplankton absorb carbon dioxide and release oxygen as they grow. When the phytoplankton die, a fraction of them sink to the ocean floor, carrying carbon with them. Over the course of Earth's history, the oceans have become the primary sink for atmospheric carbon dioxide. Since carbon dioxide is a greenhouse gas (it traps heat at Earth's surface), Earth would be a much warmer place without phytoplankton. In some areas, phytoplankton blooms are so abundant that their death and decomposition often robs the water of dissolved oxygen. As the plants die, they sink to the ocean floor where bacteria consume them. There is so much plant material that the bacteria use all of the oxygen available in the water before they finish breaking down the plants, creating a dead-zone in the water where fish cannot survive. Anaerobic bacteria, which do not require oxygen, take over in the decomposition process, releasing sulfur dioxide as a byproduct. The sulfur dioxide interacts with the ocean water to create solid sulfur and hydrogen sulfide, a poisonous gas, which eventually erupts to the surface, sometimes killing fish.

With phytoplankton production playing such a vital role in ocean health and global climate, it has become increasingly important to monitor the spring blooms. Scientists use these data to model near- and long-term effects on the ecology. The scientists determined that the existing ocean production satellite record is sufficient to determine that the cause of the traditional North Atlantic spring bloom of phytoplankton central to understanding and modeling the ecology of the oceans is different than as historically understood. They used NASA data to detail the mechanisms causing the spring bloom in the North Atlantic Ocean, a very productive and fisheries-rich area. Through modeling efforts incorporating a range of satellite products, they improved descriptions of carbon cycling in U.S. coastal waters and of physical mechanisms controlling the dominance of phytoplankton functional types in the global ocean.

For more information on this story go to *http://disc.sci.gsfc.nasa.gov/oceancolor/additional/science-focus/ocean-color/science_focus.shtml/nab.shtml*.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Demonstrate progress in quantifying global land cover change and terrestrial and marine productivity and in improving carbon cycle and ecosystem models. Progress will be evaluated by external expert review.	7ESS3 Green	8ES03 Green	9ES10 Green	10ES07 Green
Develop missions in support of this Outcome, as demonstrated by completing the Landsat Data Continuity Mission (LDCM) Confirmation Review.	None	None	9ES11 Green	10ES08 Green
Develop missions in support of this Outcome, as demonstrated by conducting the acquisition strategy meeting for the OCO-2 mission, defining the implementation and acquisition approach for the reconstituted mission.	7ESS6 Yellow	8ES04 Yellow	9ES2 Green	10ES22 Green

Outcome 3A.4: Progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA/J. Allen, Earth Observatory

By the end of July 2009, California was well into its third dry year in a row, reducing vegetation cover, as shown here in an image made from data collected by NASA's Terra satellite. On average, the state's reservoirs were running low. The Westlands, reports National Public Radio, is the United State's biggest irrigated region. Water pumped into the region from the Sacramento and San Joaquin River Delta via the San Luis Reservoir supports farms where much of the nation's fruit, nuts, and produce are grown. Like many other places throughout the world, California faces difficult decisions about managing its limited water resources. The ability to predict drought and plan accordingly has become an important tool for regional and state governments.

NASA creates good NEWS for Earth's energy and water cycle

The cycling of energy and water has obvious and significant implications for the health and prosperity of society. The availability and quantity of water is vital to life on Earth and helps to tie together Earth's lands, oceans, and atmosphere into an integrated physical system. The NASA Energy and Water cycle Study (NEWS) has compiled the first-ever satellite-based energy and water cycle climatology.

The 10 year climatology includes monthly, continental, and oceanic averages of Earth's precipitation, evaporation, water vapor, and radiation balance. The radiation balance compares the amount of solar radiation coming into the atmosphere with infrared radiation emitted from Earth's surface, which either passes through the atmosphere into space or is absorbed and re-emitted by greenhouse gases in the atmosphere. This radiation balance warms the planet's surface. This new integrated global water and energy assessment is being used in conjunction with NASA's Modern Era Retrospective-Analysis for Research and Applications (MERRA) reanalysis to study and improve predictions of weather and climate variability. These integrated water and energy satellite studies also have provided insights to the mechanisms and severity of mid-western U.S. floods and droughts, helping to mitigate future damage caused by these extremes.

More about NEWS is available at *http://news.cisc.gmu.edu/*.

More about MERRA is available at *http://gmao.gsfc.nasa.gov/merra/*.

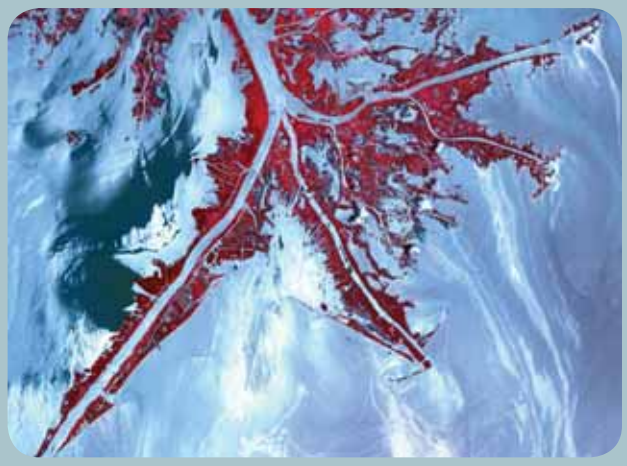
FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Develop missions in support of this Outcome, as demonstrated by completing Aquarius Operational Readiness Review (ORR).	None	8ES10 Yellow	9ES4 Green	10ES02 Yellow
Develop missions in support of this Outcome, as demonstrated by completing the Global Precipitation Measurement (GPM) Critical Design Review (CDR).	None	8ES06 Yellow	9ES8 Yellow	10ES06 Green
Demonstrate progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability. Progress will be evaluated by external expert review.	7ESS5 Green	9ES05 Green	9ES13 Green	10ES09 Green
Develop missions in support of this Outcome, as demonstrated by completing the SMAP Preliminary Design Review (PDR).	None	None	9ES14 Green	10ES10 Yellow

Why NASA did not achieve APG 10ES02: Due to delays in the development of the international partner's Mission Operations System, the ORR was not completed in FY 2010.

Plans for achieving 10ES02: A specific date has not been identified, but NASA estimates this to be in early 2011. However, any delays to the overall mission schedule could cause the ORR to move further.

Why NASA did not achieve APG 10ES10: The Soil Moisture Active and Passive (SMAP) mission PDR is currently scheduled for March 2011, consistent with the schedule presented at the mission's Initial Confirmation Review.

Plans for achieving 10ES10: Currently, all pre-cursor events (i.e., peer reviews, sub-system PDRs) are proceeding on or ahead of plan. However, a launch vehicle has not yet been selected for SMAP, and this could impact the scheduling of the PDR. NASA is addressing this issue, but it is not expected to be resolved until after March.



NASA in the Spotlight

NASA Deploys Planes, Targets Satellites to Aid in Oil Spill Response

This spring when U.S. disaster response agencies needed help monitoring the Deepwater Horizon BP oil spill in the Gulf of Mexico, NASA mobilized its many remote-sensing assets.

As part of the national response to the spill, NASA deployed its instrumented research aircraft the Earth Resources-2 (ER-2) to the Gulf on May 6. The Agency also made extra satellite observations and conducted additional data processing to assist the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), and the Department of Homeland Security monitor the spill. Researchers also measured changes in vegetation along the coastline and assessed where and how oil was affecting marshes, swamps, bayous, and beaches that are difficult to survey on the ground. The combination of satellite and airborne imagery helped NOAA forecast the trajectory of the oil and document changes in the ecosystem.

For more on this story go to *http://www.nasa.gov/topics/earth/features/oil_spill_er2_feature.html*.

Image above: Oil from the Deepwater Horizon spill laps around the mouth of the Mississippi River delta in this May 24, 2010, image from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument on NASA's Terra spacecraft. The oil appears silver, while vegetation is red. (Credit: J. Allen/NASA; U.S./Japan ASTER Science Team)

Outcome 3A.5: Progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution.

FY07	FY08	FY09	FY 2010
Yellow	Yellow	Green	Green

Credit: NASA

On August 5, 2010, an enormous chunk of ice, roughly the size of Manhattan, broke off the Petermann Glacier, along the northwestern coast of Greenland, visible near the center of this real-time image taken by NASA's Aqua satellite. The Petermann Glacier lost about one-quarter of its 70-kilometer-long (40-miles) floating ice shelf in a process called calving, when a large chunk of an iceberg breaks away. Icebergs calving off the giant glacier are not unusual—it has occasionally calved large icebergs—but the one from August is the largest to form in the Arctic since 1962. For more on IceBridge go to: *http://www.nasa.gov/mission_pages/icebridge/index.html*.

IceBridge finds warm waters in Greenland glacier

The Arctic Ocean is covered by a dynamic layer of sea ice that grows each winter and shrinks each summer, reaching its yearly minimum size each fall. Between March and May 2010, NASA's IceBridge mission completed a field campaign to monitor Greenland and Arctic sea ice, focusing on areas where glaciers and ice sheets have been undergoing rapid changes and finding warm water in surprising places.

IceBridge, which is bridging the gap between NASA's Ice, Cloud and Land Elevation Satellite (ICESat) I and II missions, is the largest airborne survey of Earth's polar ice ever flown. These flights are providing a yearly, multi-instrument look at the behavior of the rapidly changing features of the Greenland and Antarctic ice. Scientists are using the data to create an unprecedented three-dimensional view of the cryosphere, which is an integral part of the global climate system. The melting cryosphere is a major factor in sea-level rise, which has enormous significance to coastal populations throughout the world. During the 2010 Arctic campaign, scientists discovered warm waters in a glacier fjord in East Greenland, and studies revealed that the waters are replenished by wind-driven circulation. Furthermore, in West Greenland measurements of ocean currents, temperature, and salinity suggest that submarine melt rates (the melting of ice below the waterline) are twice as high.

Both discoveries lend support to the idea that ocean warming may, along with calving, be the most important factors in mass loss from the world's major ice sheets. Sea ice reached its minimum extent in 2010 on September 29, when coverage dropped to 1.78 million square miles, according to scientists at the National Snow and Ice Data Center. The extent was lower than the 2009 minimum but remained above the record minimums reached in 2007 and 2008. 2010 saw continued loss of ice from the Greenland and Arctic sea ice cover (especially from the oldest, thickest ice), as well as from the West Antarctic ice sheets.

NASA satellites, such as Aqua, and airborne surveys continue to provide important records of these changes. They also improve understanding of the relationship between ice cover and the oceans and atmosphere, critical for creating predictive models and for developing accurate global climate models.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Develop missions in support of this Outcome, as demonstrated by completing Aquarius Operational Readiness Review (ORR).	None	8ES10 Yellow	9ES4 Green	10ES02 Yellow
Conduct flight programs in support of this Outcome, as demonstrated by achieving mission success criteria for Aura.	None	None	None	10ES03 Green
Demonstrate progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution. Progress will be evaluated by external expert review.	7ESS7 Green	9ES07 Green	9ES15 Green	10ES11 Green
Develop missions in support of this Outcome, as demonstrated by completing the Pre-Ship Comprehensive Performance Test for Glory.	7ESS8 Yellow	8ES09 Yellow	9ES3 Red	10ES21 Yellow
Develop missions in support of this Outcome, as demonstrated by conducting the acquisition strategy meeting for the OCO-2 mission, defining the implementation and acquisition approach for the reconstituted mission.	7ESS6 Yellow	8ES04 Yellow	9ES2 Green	10ES22 Green
Develop missions in support of this Outcome, as demonstrated by completing the ICESat-II Initial Confirmation Review.	None	None	9ES16 Yellow	10ES12 Green

Why NASA did not achieve APG 10ES02: Due to delays in the development of the international partner's Mission Operations System, the ORR was not completed in FY 2010.

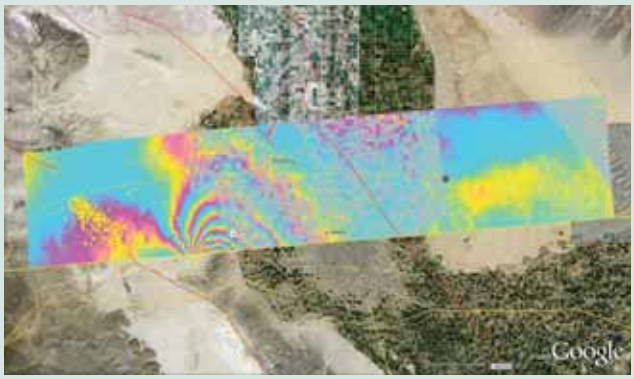
Plans for achieving 10ES02: A specific date has not been identified, but NASA estimates this to be in early 2011. However, any delays to the overall mission schedule could cause the ORR to move further.

Why NASA did not achieve APG 10ES21: The Glory Pre-Ship Comprehensive Performance Test began on September 17, 2010, but was not completed until October 4, 2010. The test was delayed primarily due to resolution of spacecraft hardware anomalies.

Plans for achieving 10ES21: The test was completed successfully on October 4, 2010.

Outcome 3A.6: Progress in characterizing and understanding Earth surface changes and variability of Earth's gravitational and magnetic fields.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green



Credit: NASA/JPL/USGS/Google

The image shows a UAVSAR interferogram of the magnitude 7.2 Baja California earthquake on April 4, 2010, overlaid atop a Google Earth image of the region. Major fault systems are shown by red lines, while recent aftershocks are denoted by yellow, orange, and red dots. For more about this and other radar images, go to: *http://www.nasa.gov/topics/earth/features/UAVSAR20100623.html*.

Missions new and old prove their benefit

NASA's projects for characterizing gravitational fields and Earth's surface changes have been very successful. The capabilities resulting from these projects have proven useful in forecasting seismic events on a variety of time scales. In FY 2010, NASA has continued to invest in these capabilities for the public benefit.

NASA has invested in the development of real-time Global Differential Global Positioning System (GDGPS) network, both for the prediction of hazards like earthquakes and tsunamis and for navigation. GDGPS demonstrated its value by predicting and observing the tsunami generated by the Chilean earthquake of February 27, 2010. The subsequent observation of the tsunami by the Jason-I and -II Earth observation satellites confirmed that the amplitudes predicted by the system's model were remarkably accurate.

This past year was the first full year of operations for NASA's unmanned airborne observation platform, and it was a highly successful year. The Uninhabited Aerial Vehicle Synthetic Aperture Radar, or UAVSAR, captured the first-ever airborne InSAR (Interferometric Synthetic Aperture Radar) measurement of ground deformation due to an earthquake (the northern extent of the magnitude 7 earthquake in Baja California). NASA-funded investigators also led the effort in the use of satellite InSAR observations to respond to the large earthquakes in Baja California, Haiti, and Chile.

The Gravity Recovery and Climate Experiment (GRACE) twin spacecraft continued to provide monthly measurements of Earth's gravity field, helping scientists to make major advances in observing and understanding the mass flux associated with the regional changes in gravity. Specific phenomena observed by GRACE include mass loss in the polar ice caps, flooding events in major river basins, decadal signals associated with ground water depletion, and ocean bottom pressure changes leading to changes in the ocean bottom currents. In June 2010, NASA and the German Aerospace Center (DLR) signed an agreement to extend the mission through the end of its on-orbit life, which is expected in 2015. GRACE's monthly maps are up to 100 times more accurate than existing maps, substantially improving the accuracy of techniques used by oceanographers, hydrologists, glaciologists, geologists, and climate scientists.

More information on the NASA Global Differential GPS System is available at *http://www.gdgps.net/*.

More information on the UAVSAR is available at *http://uavsar.jpl.nasa.gov/*.

More information on GRACE can be found at *http://www.csr.utexas.edu/grace/*.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Develop missions in support of this Outcome, as demonstrated by completing the Landsat Data Continuity Mission (LDCM) Confirmation Review.	None	None	9ES11 Yellow	10ES08 Green
Demonstrate progress in characterizing and understanding Earth surface changes and variability of Earth's gravitational and magnetic fields. Progress will be evaluated by external expert review.	7ESS10 Green	8ES11 Green	9ES17 Green	10ES13 Green

Outcome 3A.7: Progress in expanding and accelerating the realization of societal benefits from Earth system science.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

NASA Earth Science data serves the public, at home and abroad

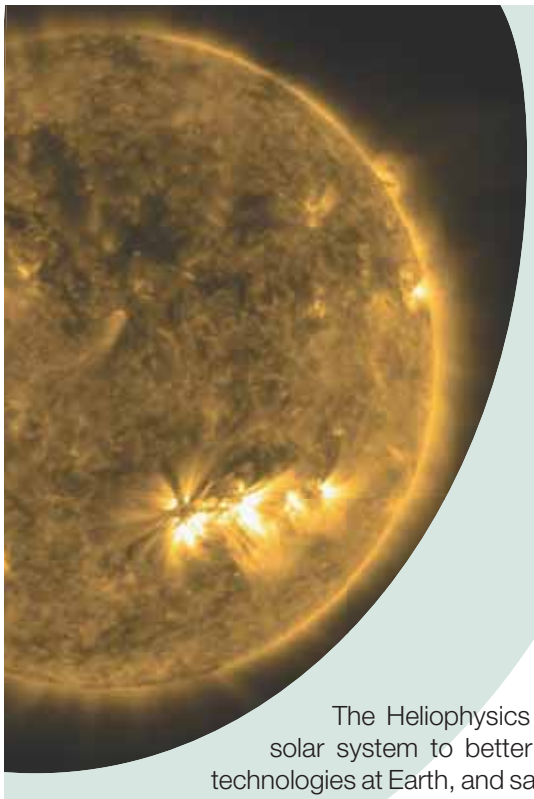
Throughout FY10, NASA and the U.S. Agency for International Development (USAID) worked to establish the new SERVIR–Himalaya node in Kathmandu, Nepal, which was formally inaugurated on October 5, 2010. SERVIR–Himalaya is the third global node in the SERVIR Regional Visualization and Monitoring System, and is hosted by the International Centre for Integrated Mountain Development. It expands the collaboration between NASA, USAID, and their international partners to meet development challenges by "linking space to village." Approximately 1.3 billion people depend on the ecosystem services, e.g., abundant fresh water, provided by the Himalayan mountains, yet the region is known as Earth's "third pole" because of its inaccessibility and the vast amount of water stored there in the form of ice and snow SERVIR integrates Earth science data from NASA satellites with geospatial information products from other government agencies to support and expand the International Centre for Integrated Mountain Development's focus on critical regional issues such as disaster management, biodiversity conservation, trans-boundary air pollution, snow and glacier monitoring, mountain ecosystem management, and climate change adaptation. Since 2005, SERVIR has served the Mesoamerican region and the Dominican Republic from the Water Center for the Humid Tropics of Latin America and the Caribbean, which is based in Panama. SERVIR also has served East Africa since 2008, operating from the Regional Center for Mapping of Resources for Development in Nairobi, Kenya.

For more on SERVIR go to *http://www.nasa.gov/mission_pages/servir/10-154.html*.

The Natural Disasters program coordinated NASA's response to several international and national disasters in 2010. Following the Haiti Earthquake in January 2010, NASA spaceborne and airborne instruments observed and monitored the island. Pre-earthquake satellite imagery compared with post-earthquake imagery enabled the detection of landslides and potential areas of unstable soils susceptible to erosion and mudslides.

After the explosion and collapse of the Deepwater Horizon oil platform on April 20, 2010, NASA contributed its satellite and aircraft research capabilities in support of the broader national effort to respond to the oil spill in the Gulf of Mexico. This effort continued throughout the summer and into October. NASA supplied data from six different instruments on four research spacecraft, as well as five instruments deployed on dedicated aircraft missions. From their vantage point in low Earth orbit, the Moderate-resolution Imaging Spectroadiometer (MODIS) instrument observed a 2,300 kilometer wide swath of ocean surface and resolved details down to about 250 meters. These remote sensing assets collected data on the spill four times every 24 hours and provided large-scale visible and infrared views of the slick. Data from higher resolution instruments (Advanced Spaceborne Thermal Reflection Radiometer and the Advanced Land Imager) can show details as small as ten meters across, but for a much narrower swath of ocean. NASA aircraft missions over the spill supplemented the satellite data with higher resolution imaging. The U.S. Geological Survey (USGS) and NOAA used these NASA measurements as a key component in estimating the volume and concentration of surface oil in the Gulf of Mexico.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Issue 12 reports with partnering organizations that validate using NASA research capabilities (e.g., observations and/or forecast products) could improve their operational decision support systems.	7ESS11 Green	8ES12 Green	9ES18 Green	10ES14 Green
Increase the number of distinct users of NASA data and services.	None	8ES13 Green	9ES19 Green	10ES15 Green
Maintain a high level of customer satisfaction, as measured by exceeding the most recently available federal government average rating of the Customer Satisfaction Index.	None	8ES14 Green	9ES20 Green	10ES16 Green



Sub-Goal 3B

Understand the Sun and its effects on Earth and the solar system.

Summary of Ratings for Sub-Goal 3B	
3 Outcomes	8 APGs
Green = 3	Green = 8
Yellow = 0	Yellow = 0
Red = 0	Red = 0
White = 0	White = 0

FY 2010 Cost of Performance (Dollars in Millions)
$1,019.9

The Heliophysics Division explores the Sun's connection with, and effects on, the solar system to better understand the interaction between the Earth and Sun, protect technologies at Earth, and safeguard space exploration. NASA Heliophysics missions are making historical strides toward understanding and predicting space weather and the space environment.

The Sun's energy output creates an immense structure of complex magnetic fields and winds, known as the heliosphere, which stretches far beyond the orbit of Pluto. Using a group of robotic science spacecraft to form an extended network of sensors, NASA observes solar variability and the response of Earth and other planets to such variability. Over a dozen satellites comprise the Heliophysics System Observatory to provide unprecedented wide-ranging coverage of the vast Sun–Earth system. The satellites provide key links to understanding the complex interactions between the Sun and the solar system, including the first detailed measurements of the Sun's meridional flow, the conveyor belt-like magnetic field running from Earth's equator to its poles. Also observed for the first time is the ground state of Earth's atmosphere and ionosphere. At the same time, advances in computational capabilities and hardware yielded complex predictive models with ever-increasing realism and closure with data.

This timely convergence of discovery and assets has enabled the Heliophysics Division to make great strides toward understanding and predicting space weather, the space environment, and how Earth will respond to the Sun's activity.

Benefits

Due to an increased reliance on space-based technologies, the modern world is now more vulnerable and sensitive to space weather and solar activity. A report issued in December 2008 by the Space Studies Board of the U.S. National Academies addressed the impacts of space weather events on human technologies. The report, *Severe Space Weather Events: Understanding Societal and Economic Impacts*, estimates that the economic cost of a severe geomagnetic storm could cost the United States up to $2 trillion during the first year, with long recovery times resulting from damage to large power transformers and other necessary but hard-to-replace facilities.

Image above: The Solar Dynamics Observatory (SDO) watched in extreme ultraviolet light as a fairly strong active region rotated across the center of the Sun over the course of four and a half days (July 23 – 27, 2010). The looping arcs above this active region were in ever changing motion the entire time. (Credit: NASA/SDO Team)

NASA partners with NOAA to operate a fleet of scientific satellites to observe space weather. NASA spacecraft, equipped with space weather beacons, provide real-time science data to space weather forecasters. NASA cooperates with other agencies to enable new knowledge in this area and to measure conditions in space critical to both operational and scientific research.

Equally important, Earth's local space environment provides a convenient venue for studying the plasmas that make up most of the visible universe. Under the control of magnetic fields, plasmas organize into galactic jets, radio filaments, supernova bubbles, accretion disks, galactic winds, stellar winds, stellar coronas, sunspots, heliospheres, magnetospheres, and radiation belts. Studying these phenomena in Earth's own neighborhood gives NASA the opportunity to understand the underlying mechanics of distant astrophysical plasma systems that are inaccessible to direct study.

Risks to Achieving Sub-Goal 3B

The Heliophysics Division, along with NASA's other Science divisions, continues to be concerned with the increased cost and the reduced availability of expendable launch vehicle (ELV) options. Over the course of the last decade, the Delta II has been the workhorse for launching many robotic mid-sized spacecraft. Without this option, NASA has access only to costlier evolved ELVs (Delta IV, Atlas V), which were designed to launch payloads larger than planned for many of the Heliophysics missions identified in the NASA Science Plan. Possible cost growth in the evolved ELV class is an additional source of concern. These problems cannot be avoided until new commercial launch vehicles become available, potentially reducing the cost of launching missions.

Rising mission costs also present a risk, as the reduced mission frequency impacts the systems approach to Heliophysics. NASA is aggressively exploring options to maintain a vital Heliophysics flight program. With the release of the Explorer Announcement of Opportunity (AO) on November 1, 2010, the program is taking a vital step toward maintaining an appropriate mix of small and large missions.

Outcome 3B.1: Progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: UCAR

When the thermosphere contracts, and the upper regions at the edge of space become less dense, objects in orbit experience less drag. This means that orbital debris, including satellites that have ceased operations, will spend a longer time in orbit, where they can be a hazard to spacecraft in operations.

NASA Heliophysics passes major milestones contributing to 3B.1

The Solar Dynamics Observatory (SDO) launched February 11, 2010—The observatory is returning images that demonstrate an unprecedented capability for scientists to understand the Sun's dynamic processes.

Magnetospheric Multiscale (MMS) completed its critical design review (CDR) and is finishing final design prior to the start of integration and testing.

NASA completed instrument selections for the Solar Probe Plus mission.

Go to *Missions At a Glance* for more information on these missions.

The Sun and humankind conspire to contract the thermosphere

NASA-funded researchers are monitoring a big event in Earth's atmosphere. High above the surface where the atmosphere meets space, a rarefied layer of gas called the thermosphere recently collapsed and now is rebounding again.

The collapse happened during the deep solar minimum of 2008-2009, a fact that comes as little surprise to researchers. The thermosphere always cools and contracts when solar activity is low. In this case, however, the magnitude of the collapse was two to three times greater than could be explained by low solar activity. This was discovered by NASA's Coupled Ion-Neutral Dynamics Investigation (CINDI) instrument, aboard the Air Force Communication/Navigation Outage Forecast System (C/NOFS) satellite. The C/NOFS space weather mission was designed to explore disturbances in Earth's ionosphere that can cause disruption of navigation and communication signals.

The thermosphere is where solar radiation makes first contact with Earth. It intercepts extreme ultraviolet (EUV) photons from the Sun before they can reach the ground. When solar activity is high, solar EUV warms the thermosphere, causing it to expand. When solar activity is low, it contracts. The extra contraction may have been caused by carbon dioxide. When carbon dioxide, produced by human-related activities near the surface, gets into the thermosphere, it acts as a coolant, shedding heat via infrared radiation. As the thermosphere rebounds, CINDI and other spacecraft can collect important clues about how trends in global climate could alter the composition of the thermosphere, changing its thermal properties and the way it responds to external stimuli.

For more on this story, visit *http://science.nasa.gov/science-news/science-at-nasa/2010/15jul_thermosphere/*.

Identifying the particle acceleration region of a solar flare

Solar flares are among the most energetic phenomena in the solar system, releasing vast amounts of energy in a few minutes, both heating the local solar atmosphere to millions of degrees and accelerating particles to relativistic speeds. Scientists think the release of magnetic energy is the source of energy for the flares, but they did not know the details of the particle acceleration mechanism. Even the location of the acceleration site was under debate, although it was generally assumed to be in the corona, the glowing plasma "atmosphere" that surrounds the Sun. NASA's Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) mission and the Nobeyama

Radioheliograph may have solved at least part of this mystery.

Recent observations have demonstrated the presence of high-energy electrons high in the solar corona, in an area called "above-the-loop-top" because it is above the region where the post-solar flare magnetic loops form. The observations establish that the electron population was produced by a mechanism that accelerates all the available electrons, indicating in turn that the above-the-loop-top source is the acceleration region itself.

Additional studies are planned, in particular with Hinode and the Solar Dynamics Observatory, to verify these findings. The study of particle acceleration sources in the solar corona is crucial in gaining an understanding of how solar flares occur and evolve and how the vast amounts of energy released by stars like the Sun travel through interplanetary space and affect planetary environments.

Credit: NASA/SDO/AIA

Earth is superimposed next to an image of a coronal loop taken by the Solar Dynamics Observatory in March 2010 to give a sense of scale. These highly structured and elegant loops are a direct consequence of the twisted solar magnetic flux within the solar body. They are often found with sunspots at their footpoints. The upwelling magnetic flux pushes through the photosphere, the core of the Sun that appears to emit its light, exposing the cooler plasma below.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Demonstrate progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium. Progress will be evaluated by external expert review.	7ESS13 Green	8HE01 Green	9HE1 Green	10HE01 Green
Develop missions in support of this Outcome, as demonstrated by completing the Magnetospheric Multiscale (MMS) spacecraft Critical Design Review (CDR).	7ESS15 Red	8HE02 Green	9HE2 Green	10HE02 Green
Develop missions in support of this Outcome, as demonstrated by completing the Geospace Radiation Belt Storm Probes Critical Design Review (CDR).	7ESS16 Green	8HE04 Green	9HE3 Green	10HE03 Green
Develop missions in support of this Outcome, as demonstrated by the award of Solar Probe Plus instrument contracts.	None	None	None	10HE04 Green
Conduct the flight program in support of this Outcome, as demonstrated by achieving mission success criteria for Hinode (Solar-B), THEMIS, and IBEX.	None	None	9HE5 Green	10HE05 Green

Outcome 3B.2: Progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA

Astronauts aboard the ISS photographed these blue noctilucent clouds in July 2008. Noctilucent clouds form on the edge of space, 50 miles above Earth, throughout the polar summer. A dramatic new AIM finding reveal that Earth's lower and upper atmospheres constitute a globally coupled system: Noctilucent clouds in one hemisphere's mesosphere occasionally respond directly to wind speeds in the opposite hemisphere's stratosphere, more than 12,400 miles away. This global scale coupling takes place through wave interactions that have become the focus of intense study.

NASA Heliophysics passes major milestones contributing to Outcome 3B.2

Radiation Belt Storm Probes (RBSP) mission has completed its critical design review (CDR) and has been approved to proceed into implementation activities.

Go to *Missions At a Glance* for more information on this mission.

Ice clouds near the edge of space

The genesis of beautiful, wispy noctilucent (night-shining) clouds has been an ongoing mystery. First noticed in the late 19th century, people had to go to places like Scandinavia, Siberia, and Scotland to see them. In recent years, however, they have been sighted from mid-latitudes like Colorado and Utah. Researchers began to wonder if their origin and migration is connected with climate change. NASA's Aeronomy of Ice in the Mesosphere (AIM) mission has provided major advances in understanding the relationship between noctilucent clouds and the environment in which they form.

AIM has revealed the sudden response of cloud formation to temperature excursions below the frost point, much like the turning on of a geophysical light bulb. Cloud brightness and occurrence respond dramatically to even very small changes in the surrounding temperature. Moreover, AIM has confirmed that it is the change in temperature, as opposed to a change in the abundance of the background water vapor that controls the seasonal onset of cloud formation. However, water vapor does appear to play an important role in governing the subsequent behavior of the clouds, because its availability limits the amount of ice that can be formed.

The AIM scientists also have been able to show that when they know the mesospheric temperature and water vapor abundances, they can model a number of important features of the clouds, and from this develop a predictive capability. NASA has extended AIM's mission, which began with its 2007 launch, to 2012. The science team believes that with additional data they can find out why the clouds first appeared in the late 1800s, why they are spreading, and if they are connected to human activity or some other process.

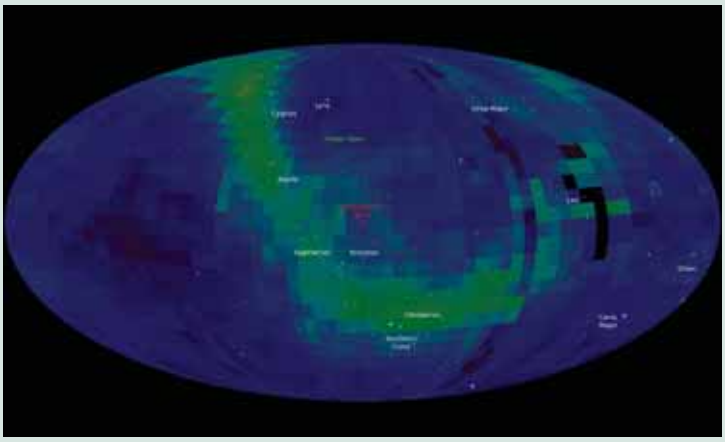
For more on this story go to *http://science.nasa.gov/science-news/science-at-nasa/2008/25aug_nlc/*.

Mapping the solar system's protective "bubble"

NASA's Interstellar Boundary Explorer (IBEX) has provided the first global views of the protective boundary, called the heliosphere, that surrounds the solar system and shields it from the harmful radiation in the galactic medium. The data reveal that conditions at the edge of the solar system may be much more dynamic than previously thought.

The maps are made by collecting particles known as energetic neutral atoms (ENAs), which are created by the collisions of solar wind particles with the in-flowing interstellar gas. The maps show a remarkably bright and narrow "ribbon" of ENAs not predicted by any model or theory. The observations indicate a blunt termination shock (a bubble-shaped area where the solar wind is slowed by pressure from gas outside the solar system) that is wide in longitude and flattened latitudinally. Scientists are still debating the origin of this ribbon, but it appears to show the imprint of the galactic magnetic field, which shapes and controls the global heliosphere.

Meanwhile, the two Voyager missions continue making direct samples of the most distant plasmas ever measured. For example, scientists expected the supersonic solar wind to be abruptly slowed when encountering the solar system's interface with the intergalactic wind, forming a termination shock. However, Voyager 2 has discovered that ions in the solar wind bounce back and forth across the shock formation, slowly gaining speed as they drain energy from the supersonic wind. So many ions were extracting energy from the solar wind, in fact, that the solar wind had slowed by 20 percent before the final shock boundary, resulting in a weaker shock than expected.



Credit: IBEX Team/Goddard Scientific Visualization Studio/ESA

The ribbon observed by IBEX is a narrow bright feature that spans much of the nighttime sky linking together the summer constellation of Cygnus, the swan, Aquila, the eagle, the center of the Milky Way galaxy, Ursa Major and Ursa Minor.

These results show that the interaction between the solar system and the interstellar medium has remarkable structure and dynamics. The results have already changed scientists' understanding about the solar system's home in the galaxy, how galactic cosmic rays reach Earth, and how the environments surrounding other stars may or may not influence the possibility of the existence of habitable planets in other solar systems.

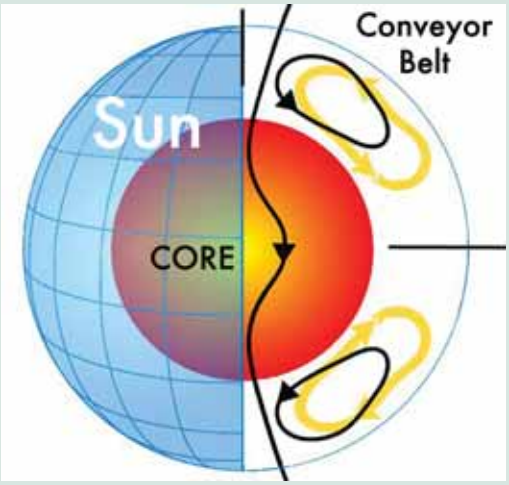
For more on IBEX's story, visit *http://science.nasa.gov/science-news/science-at-nasa/2009/15oct_ibex/*.

For more on the Voyagers' interstellar mission go to *http://voyager.jpl.nasa.gov/*.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Develop missions in support of this Outcome, as demonstrated by completing the Magnetospheric Multiscale (MMS) spacecraft Critical Design Review (CDR).	7ESS15 Red	8HE02 Green	9HE2 Green	10HE02 Green
Develop missions in support of this Outcome, as demonstrated by completing the Geospace Radiation Belt Storm Probes Critical Design Review (CDR).	7ESS16 Green	8HE04 Green	9HE3 Green	10HE03 Green
Develop missions in support of this Outcome, as demonstrated by the award of Solar Probe Plus instrument contracts.	None	None	None	10HE04 Green
Demonstrate progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields. Progress will be evaluated by external expert review.	7ESS19 Green	8HE03 Green	9HE6 Green	10HE06 Green
Conduct the flight program in support of this Outcome, as demonstrated by achieving mission success criteria for THEMIS.	None	None	9HE7 Green	10HE07 Green

Outcome 3B.3: Progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green



Credit: NASA

The meridial flow is like a conveyor belt—a massive circulating current of fire (hot plasma) within the Sun. It has two branches, north and south, each taking about 40 years to complete one circuit. Researchers believe the turning of the belt controls the sunspot cycle. The top of the belt skims the surface of the sun, sweeping up magnetic elements and carrying them toward the poles. SOHO is able to track those magnetic elements, revealing the speed of the underlying flow.

NASA Heliophysics passes major milestone contributing to Outcome 3B.3

SDO launched February 11, 2010—The first Living with a Star (LWS) mission and the newest component of the Heliosphysics Great Observatory, SDO has a downlink data rate of 1.5 Terabytes per day, which allows high time cadence, full disk images of the Sun to be obtained in multiple wavelength bands at a maximum rate of one image every 10 seconds.

Go to *Missions At a Glance* for more information on this mission.

Understanding an unusually long solar cycle

In the outer third of the Sun, energy is transported by convective motions akin to those of water boiling in a pot. Scientists believe the approximate 11-year solar activity cycle is driven by compact elements of magnetic field moving through what is called the "convection zone." New results by researchers using data from the Solar and Heliospheric Observatory (SOHO) have found a distinctive signature that may explain why the current solar cycle has been so long.

The researchers used a method that examines variations in the meridional flow (a poleward surface wind) of strong magnetic field elements in the Sun's photosphere, or the ball-shaped surface that is perceived to emit light. SOHO took measurements of the flow pattern from 1996 to 2010, and the subsequent research shows that one component of the surface flow velocity has remained at a nearly constant and high value throughout the recent extended (2008 through 2009) solar minimum. These findings contradicted models that said a fast-moving flow should speed up sunspot production. The models suggest that the flow sweeps up magnetic fields from the Sun's surface and drags them down to the inner dynamo. There the fields are amplified to form the underpinnings of new sunspots. A fast-moving flow should accelerate this process.

The reasons that sunspots are not forming may be found at the Sun's poles, where data showed magnetic field strength to be low. At the same point in the cycle for the previous solar minimum in 1996 the surface velocity of the meridional flow would have already started to decrease in magnitude. The fact that the surface flow speed is still high supports models that predict that faster surface flow speeds lead to weaker polar magnetic fields and, hence, a longer solar minimum.

For more on this story, visit: *http://science.nasa.gov/science-news/science-at-nasa/2010/12mar_conveyorbelt/*.

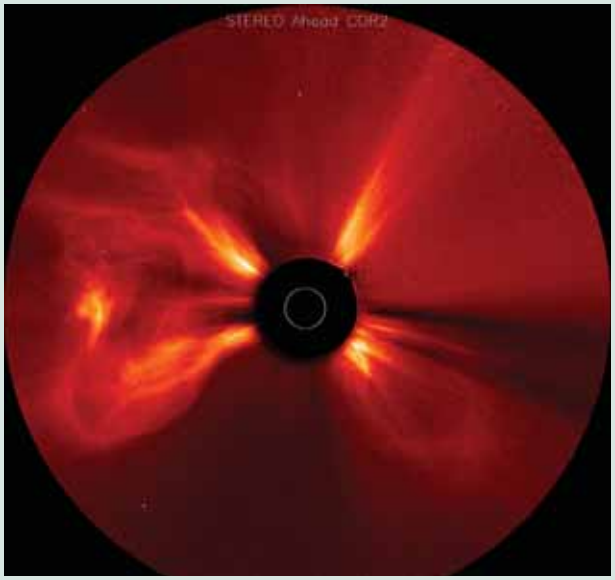
Advances in predicting solar eruptions

Coronal mass ejections (CMEs) are huge bubbles of gas threaded with magnetic field lines that are ejected from the Sun over the course of several hours. CMEs disrupt the flow of the solar wind and produce disturbances that strike Earth with sometimes catastrophic results. Observations from widely-separated spacecraft, like NASA's two Solar Terrestrial Relations Observatory (STEREO) spacecraft, have spurred progress in the development of more realistic and more reliable numerical models of interplanetary CMEs and solar energetic particle (SEP) events.

Tracking CMEs and SEPs continuously from the Sun to Earth is crucial for developing practical capability in space weather forecasting, which has important consequences for life and technology on the Earth and in space.

The developments that ultimately will contribute to predictive space-weather capabilities include: using STEREO's stereoscopic viewing capability to derive the direction and speed of CMEs, thereby improving prediction of arrival times at Earth, where they can initiate geomagnetic storms; using observations from NASA's Wind spacecraft and STEREO to model how solar-wind streams govern evolution of magnetic topology during transit from the Sun; modeling large-scale CME-driven shocks to predict how SEP time-intensity profiles vary with source location and reflect structure in solar-wind streams; and improving modeling of SEP access to Earth's atmosphere and effects on space systems.

For more on STEREO go to *http://www.nasa.gov/mission_pages/stereo/main/index.html*.



Credit: NASA

A coronagraph on the STEREO A (Ahead) spacecraft caught at least two photogenic CMEs over two days, August 7 and 8, 2010. Although it appeared that this blast was Earth-directed, observations by other spacecraft showed that most of it was not headed toward Earth.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Develop missions in support of this Outcome, as demonstrated by completing the Geospace Radiation Belt Storm Probes Critical Design Review (CDR).	7ESS16 Green	8HE04 Green	9HE3 Green	10HE03 Green
Demonstrate progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers. Progress will be evaluated by external expert review.	7ESS20 Green	8HE05 Green	9HE8 Green	10HE08 Green

Sub-Goal 3C

Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.

Summary of Ratings for Sub-Goal 3C	
4 Outcomes	11 APGs
Green = 4	Green = 8
Yellow = 0	Yellow = 3
Red = 0	Red = 0
White = 0	White = 0

FY 2010 Cost of Performance (Dollars in Millions)
$2,032.9

Since humankind's first exploratory steps into the solar system, NASA has broadened its reach with an increasingly sophisticated series of explorers that have landed on asteroids, tasted the swirling gases of Jupiter's atmosphere, and collected the breath of the Sun.

In support of this Sub-goal, the Planetary Science Theme uses robotic science missions to investigate alien and extreme environments throughout the solar system. These missions help scientists understand how the planets of the solar system formed, what triggered the evolutionary paths that formed rocky terrestrial planets, gas giants, and small, icy bodies, and the origin, evolution, and habitability of terrestrial bodies. The data from these missions guide scientists in the search for life and its precursors beyond Earth and provide information to help NASA plan future human missions into the solar system.

Benefits

NASA's robotic science missions are paving the way for understanding the origin and evolution of the solar system and identifying past and present habitable locations. With this knowledge, NASA is potentially enabling human space exploration by studying and characterizing alien environments and identifying possible resources that will enable safe and effective human missions to the Moon and beyond.

Robotic explorers gather data to help scientists understand how the planets formed, what triggered different evolutionary paths among planets, and how Earth formed, evolved, and became habitable.

To search for evidence of life beyond Earth, scientists use this data to map zones of habitability, study the chemistry of alien worlds, and unveil the processes that lead to conditions necessary for life.

Image above: The surface of Saturn's moon Dione is rendered in crisp detail against a hazy, ghostly Titan. A portion of the "wispy" terrain of Dione's trailing hemisphere can be seen on the right. Also visible in this image are hints of atmospheric banding around Titan's north pole. (Credit: NASA/JPL/Space Science Institute)

Through the Near Earth Object Observation Program, NASA identifies and categorizes asteroids and comets that come close to Earth. Every day, a hundred tons of interplanetary particles drift down to Earth's surface, mostly in the form of dust particles. Approximately every 100 years, rocky or iron asteroids larger than 164 feet in diameter impact Earth, causing damage like craters and tidal waves, and about every few hundred thousand years, an asteroid larger than a kilometer threatens Earth. In the extremely unlikely event that such a large object threatens to collide with Earth, NASA's goal is to provide an early identification of these hazardous objects as far in advance (perhaps years) as possible.

Risks to Achieving Sub-Goal 3C

The supply of Plutonium-238 (Pu-238) remains a limiting factor in the exploration of the solar system. NASA has already rescoped New Frontiers-3 due to the limited supply of the Pu-238. NASA requires Pu-238 to make power for missions that travel too far from the Sun for solar power generation. Russia has suspended implementation of its contract with the Department of Energy (DOE) for purchase of Russia's remaining supplies of Pu-238. NASA continues to explore its options with the DOE, but will require appropriation of funds for FY 2011 and FY 2012 to keep the supply of Pu-238, and with it the Planetary Science Program, on track.

Outcome 3C.1: Progress in learning how the Sun's family of planets and minor bodies originated and evolved.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Looking back at Mars' watery history

As scientists explore Mars from orbiting spacecraft, landers, and rovers, they have accumulated data showing that Mars was once a wetter planet. Recent observations by NASA and its partners are filling in the history from that wetter past to the present cold, desert climate.

Data from NASA's two Mars Exploration Rovers and the orbiters Mars Odyssey and Mars Reconnaissance Orbiter (MRO), along with the European Space Agency's Mars Express orbiter, show that the planet had a relatively wet environment in which rocks weathered to clay-like minerals, and that as the climate evolved, the planet passed through a stage during which water on or near its surface was more ephemeral and very acidic. They also revealed that this early period produced diverse mineralogy deposits that may be evidence for ancient lakes, springs, or groundwater with salinity and acidity that changed over time.

Finding such a well-preserved geological record of ancient planetary change makes Mars a prime target for understanding how terrestrial planets like Earth, Mars, Venus, and Mercury evolved early in their histories. Other MRO and Mars Express radar observations provided new indications of the cyclic growth of the polar ice caps. This might be analogous to Earth's ice ages, with the ice caps growing or receding over vast timescales based on patterns of polar sunlight.

More on the story about Mars' wet era can be found at *http://mars.jpl.nasa.gov/news/whatsnew/index.cfm?FuseAction=ShowNews&NewsID=1012*.

Credit: NASA/JPL-Caltech/University of Arizona

Layers of exposed rock in the Gale Crater are a record of major environmental changes on Mars billions of years ago. Taken by MRO, the observation shows that clay minerals, which form under very wet conditions, are concentrated in layers near the bottom of the Gale stack. Above that, sulfate minerals are intermixed with the clays. And at the top is a thick formation of regularly spaced layers bearing no detectable water-related minerals. Gale is the first location where a single series of layers has been found to contain these clues in a clearly defined sequence from older rocks to younger rocks.

The Moon is a watery place

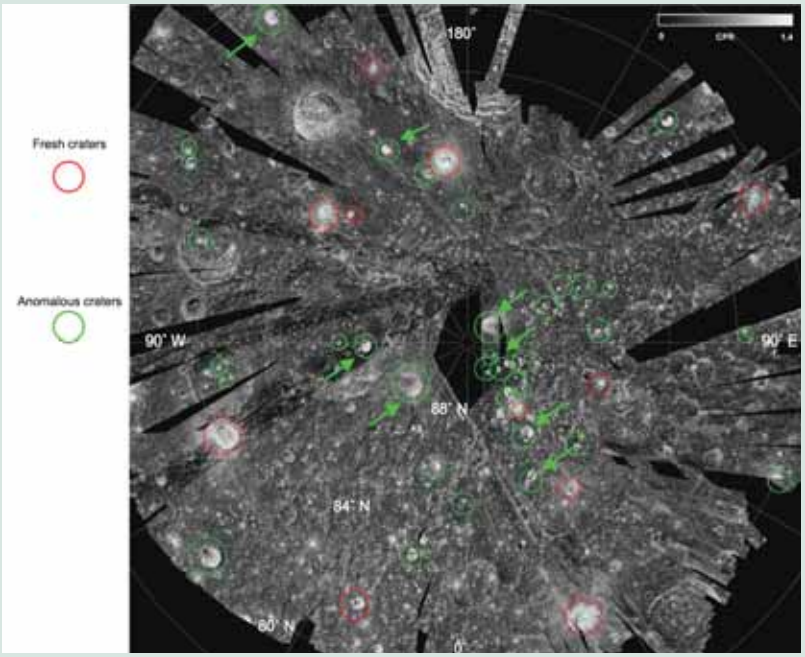
The previous concept of the Moon as a very dry destination recently shifted with the confirmation of the presence of water in FY 2010. Observations from multiple NASA and partner missions have shown that water exists in a variety of concentrations and geologic settings.

Observations by NASA's Moon Mineralogy Mapper (M3) instrument aboard the Indian Chandrayaan-1 spacecraft show hydroxyl and water molecules on the surface of the Moon. These are supported by NASA's Deep Impact spacecraft (on an extended mission called EPOXI), which has shown the entire lunar surface to be hydrated during some portions of the day. The Deep Impact data show the water molecules forming and then dissipating. So far the scientists have found three forms of moon water: the thin, ephemeral layer found by the M3; nearly-pure crater ice found by NASA's Mini-SAR instrument aboard Chandrayaan-1; and a fluffy mix of ice crystals and dirt found by NASA's Lunar Crater Observation and Sensing Satellite (LCROSS), which struck water in October 2009 in a cold, permanently dark crater at the lunar south pole. Scientists postulate that hydrogen ions from the Sun are carried by the solar wind to the Moon, where they interact with oxygen-rich minerals in lunar soil and rock to produce the water and hydroxyl molecules. This water is formed in the morning and then by lunar midday, heat from the Sun causes the molecules to evaporate. The Moon also is constantly bombarded by impactors that add to the lunar water budget. Asteroids contain hydrated minerals, and comet cores are nearly pure ice. Scientists think that much of the crater water migrates to the poles from the Moon's warmer, lower latitudes.

For more on this story, go to *http://science.nasa.gov/science-news/science-at-nasa/2010/18mar_moonwater/*.

A Mini-SAR radar map of the lunar north pole shows identified impact craters. Craters circled in green are believed to contain significant deposits of frozen water. These craters also are in permanent shadow. Scientists estimate that these craters contain over one metric ton of water.

Credit: NASA/Mini-SAR Team, LPI



FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Demonstrate progress in learning how the Sun's family of planets and minor bodies originated and evolved. Progress will be evaluated by external expert review.	7SSE1 Green	8PS01 Green	9PS1 Green	10PS01 Green
Develop missions in support of this Outcome, as demonstrated by completing the Juno Systems Integration Review (SIR).	7SSE3 White	8PS03 Green	9PS2 Green	10PS02 Green
Develop missions in support of this Outcome, as demonstrated by completing the GRAIL Critical Design Review (CDR).	None	None	9PS3 Green	10PS03 Green
Develop missions in support of this Outcome, as demonstrated by selecting concept studies for the New Frontiers 3 mission.	None	None	None	10PS04 Green
Develop missions in support of this Outcome, as demonstrated by selecting concept studies for the Discovery 12 mission.	None	None	None	10PS05 Yellow
Develop missions in support of this Outcome, as demonstrated by completing the Mars Science Laboratory (MSL) flight hardware builds and flight system assemblies.	7SSE5 Green	8PS05 Green	9PS4 Red	10PS06 Yellow

Why NASA did not achieve APG 10PS05: The acquisition timeline for the Discovery 12 mission was extended due to the complexity of the Announcement of Opportunity, which includes the potential use of radioisotope power systems.

Plans for achieving 10PS05: Twenty-eight proposals have been received. Selection of concept studies is scheduled for mid-FY 2011.

Why NASA did not achieve APG 10PS06: The flight hardware build and flight system assembly of the Sample Analysis at Mars (SAM) instrument were not completed during the designated fiscal year, due to complications in the development of the Wide Range Pump (WRP) components of the instrument. The materials originally specified as the primary component of a high-speed, high-performance bearing proved to be inadequate to provide the necessary performance on the surface of Mars, and alternative bearing materials and components had to be researched and developed.

Plans for achieving 10PS06: The development of the new bearing designs has been completed and implemented, and the finalization of the flight hardware build has resumed. The final flight units are on schedule to be delivered in early December 2010.

Outcome 3C.2: Progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA/JPL-Caltech/University of Arizona

This view of Mars, taken by MRO, shows color variations in bright layered deposits on a plateau near Juventae Chasma in the Valles Marineris region of Mars. Researchers have found that these bright layered deposits contain opaline silica and iron sulfates, consistent with low-temperature, acidic aqueous alteration of basaltic materials—or acidic water.

Finding a place for life on Mars

As described under Outcome 3C.1, the surface of Mars transitioned through a period in its history when the environment was acidic. This sort of hostile environment would challenge both the development of life and the preservation of trace signatures of that life. Research using data from NASA's Mars missions is revealing the nature of the planet's past and what it could mean for the development of life there.

If life once existed on Mars, evidence of that life would have been eradicated by a planet-wide, very acidic period. However, MRO, Mars Odyssey, and the Mars Exploration Rovers observed that these acidic environments only occurred regionally, not globally. For example, data from the rover *Opportunity* showed the existence of two separated and chemically distinct water-based environments in Meridiani Planum: a subsurface environment shielded from the atmosphere with a neutral acidity balance, and a surface environment driven to high acidity by rapid oxidation when iron in minerals was exposed to the atmosphere. Furthermore, MRO and the rover *Spirit* found carbonate deposits, which would have been destroyed by acidic conditions if acidity was globally prevalent. This is important information as Mars missions continue to search for fossil organic chemicals and other signs of past life—geologic features resulting from less acidic environments are the targets of choice.

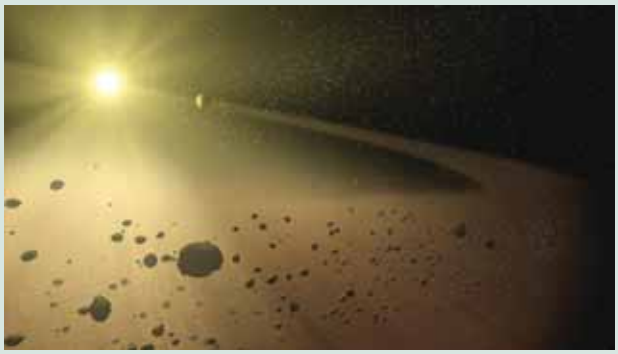
More on *Spirit*'s discovery of a non-acidic wet period on Mars can be found at *http://marsrovers.jpl.nasa.gov/newsroom/pressreleases/20100603a.html*.

Understanding the evolution of Earth's biosphere

Usually near-Earth asteroids are portrayed as planet killers, the massive rocks that destroy all plant and animal life. However, NASA research during this fiscal year has shown that despite asteroid bombardments, life on Earth has persisted. In fact, asteroids may have given early Earth some help on its way to being a living planet.

Scientists have suggested that Earth's current supply of water was delivered by asteroids, some time after the collision that produced the Moon (an event that would have vaporized any of the pre-existing water). However, until recently, no measurements of water ice on asteroids had been made. In FY 2010, two research teams, using NASA's Infrared Telescope Facility atop Mauna Kea and the Spitzer Space Telescope, imaged asteroid 24 Themis to show that ice and organic compounds are not only present on its surface, but also widespread. The

same two teams also picked up the telltale signatures of water ice and complex organic solids on the surface of asteroid 65 Cybele. Many scientists thought that these asteroids in this part of the solar system were too close to the Sun to carry water ice. Finding water ice on them now, approximately 4.6 billion years after the solar system was created, suggests that the asteroids may have delivered much of the water and the building blocks for life on Earth.



Credit: NASA/JPL-Caltech

In this artist's concept, a narrow asteroid belt filled with rocks and dusty orbital debris circle a star similar to the Sun. This belt may resemble the one that orbited the inner solar system during its early history.

In FY 2010, scientists also provided clarification about when life could have arisen on Earth and its perseverance through tumultuous events. Based on the geological record, scientists theorize that 3.8 to 4.1 billion years ago Earth went through a period when a number of asteroids and comets came through the inner solar system. Called the Late Heavy Bombardment (LHB), the impacts and near misses would have had a profound effect on the planet's early thermal, climatic, and biological evolution. It is difficult to imagine life existing under such harsh conditions, but NASA-funded researchers, using detailed thermal models of Earth during the epoch, show that under no circumstances was global sterilization on Earth reached during the bombardment. Based on this and other ongoing studies, life's origin on Earth could well have occurred as far back as 4.4 billion years ago. This analysis has shown that if such an early biosphere existed, it would have survived subsequent assaults from the LHB. Life probably arose soon after Earth formed, and has persisted here ever since.

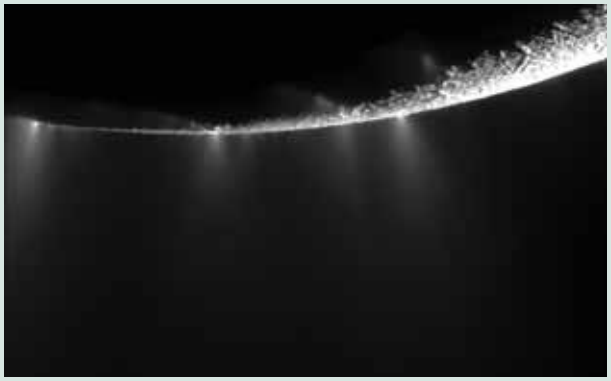
FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Develop missions in support of this Outcome, as demonstrated by completing the Juno Systems Integration Review (SIR).	7SSE3 White	8PS03 Green	9PS2 Green	10PS02 Green
Develop missions in support of this Outcome, as demonstrated by completing the Mars Science Laboratory (MSL) flight hardware builds and flight system assemblies.	7SSE5 Green	8PS05 Green	9PS4 Red	10PS06 Yellow
Demonstrate progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds. Progress will be evaluated by external expert review.	7SSE4 Green	9PS04 Green	9PS5 Green	10PS07 Green
Develop missions in support of this Outcome, as demonstrated by completing the Mars Atmosphere and Volatile Evolution Mission (MAVEN) Preliminary Design Review (PDR).	None	None	None	10PS08 Green

Why NASA did not achieve APG 10PS06: The flight hardware build and flight system assembly of the Sample Analysis at Mars (SAM) instrument were not completed during the designated fiscal year, due to complications in the development of the Wide Range Pump (WRP) components of the instrument. The materials originally specified as the primary component of a high-speed, high-performance bearing proved to be inadequate to provide the necessary performance on the surface of Mars, and alternative bearing materials and components had to be researched and developed.

Plans for achieving 10PS06: The development of the new bearing designs has been completed and implemented, and the finalization of the flight hardware build has resumed. The final flight units are on schedule to be delivered in early December 2010.

Outcome 3C.3: Progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green



Credit: NASA/JPL/Space Science Institute

Dramatic plumes, both large and small, spray water ice out from many locations along the famed "tiger stripes" near the south pole of Saturn's moon Enceladus. The tiger stripes are fissures that spray icy particles, water vapor and organic compounds. This mosaic was created from two high-resolution images taken by NASA's Cassini spacecraft on November 21, 2009.

Where there is water, there may be life

From what is known of Earth, where there is water, there is a chance for the existence of life. So for many years scientists have speculated that other worlds with water could support life. In 2010, there were two discoveries that helped scientists characterize the subsurface oceans on Europa, a moon of Jupiter, and Enceladus, a moon of Saturn.

Europa is enveloped by a global ocean about 100 miles deep, with an icy crust that may be only a few miles thick—a thin crust for such a distant, cold moon. The surface of Europa is covered with free oxygen (meaning it is not combined with other elements) and other oxidants that are key to life, but until recently scientists did not believe there was an effective way to deliver the oxygen-rich material to the subsurface ocean. New research shows that tidal forces appear to push fresh ice upward from below in a cycle that forms double ridges on at least half of Europa's surface. As ridges pile on top of ridges, older oxegenated material gets buried, shoving oxygen-rich matter downward toward the liquid water. Scientists have estimated that after one or two billion years this process could deliver enough oxygen-rich material to Europa's ocean to reach the same concentration levels as the oceans on Earth. This oxygen could provide the necessary environment to nurture life.

On Enceladus, plumes of material are ejected from vents on the icy surface, suggesting the presence of a near-surface pocket of water, like cold versions of the Old Faithful geyser in Yellowstone National Park. Previously, scientists were unable to determine if the ocean is still liquid or if it is frozen. Other moons in the solar system usually have liquid-water oceans covered by miles of icy crust, like Europa. Using the Cassini spacecraft's dust detector, scientists discovered evidence of sodium salts in the ice grains comprising Enceladus' plumes. The discovery of these salts is strong evidence that there is a liquid subsurface ocean on Enceladus—maybe only a hundred feet below the surface—because sodium salts would only exist if the plumes originate from liquid water. The next step in the research is to find out if the moon has been active and wet long enough for life to have taken hold in its interior.

More on the plumes and jets on Enceladus can be found at *http://www.nasa.gov/mission_pages/cassini/whycassini/cassini20100223.html* and *http://www.nasa.gov/mission_pages/cassini/media/cassini-20080814.html*.

Exploring habitable regions on Mars

NASA planned to launch a new mission, the Mars Science Laboratory (MSL), in 2009 to land on Mars and send out what would be the largest rover to date. Difficulties in the project's development delayed the launch to 2011. But in this cloud has been a silver lining. During this extra time NASA has investigated potential landing sites for MSL—ones that represent a diverse environmental history of environments that may have been (or may still be) habitable.

The Mars Reconnaissance Orbiter (MRO) and Mars Odyssey have provided the data needed to certify the safety and scientific potential of the final four candidate landing sites for MSL, a mission designed to assess whether Mars ever was, or is still today, an environment able to support microbial life. Two of the sites have geology of interest

in ancient paleolakes, the third site has horizontally bedded clay-bearing sedimentary rocks, and the fourth site includes clays formed during a benign environment, which would be more conducive to life, and sulfates formed in a younger, more acidic environment, which likely could not have supported life.

The delay provided an opportunity to acquire the data needed to evaluate two additional landing sites. One site has chloride-bearing sedimentary rocks. Chloride is part of many types of salt, which may have formed over time as large quantities of water evaporated. Furthermore, salt is good for preserving organic material. The other site contains carbonates, which form in wet, near-neutral conditions that could provide a favorable habitat for life. These are far more landing site options than MSL can visit, but Mars' diversity of past aqueous environments provides excellent opportunities for future lander missions searching for life beyond Earth.

More information about MSL is available at *http://marsprogram.jpl.nasa.gov/msl/*.

Credit: NASA/JPL-Caltech

The suspension system on the rover *Curiosity* easily accommodates rolling over a ramp in this September 10, 2010, test drive inside the Spacecraft Assembly Facility at NASA's Jet Propulsion Laboratory. This rover, which dwarfs its predecessors, will be able to roll over larger obstacles and access a wider-variety of terrain.

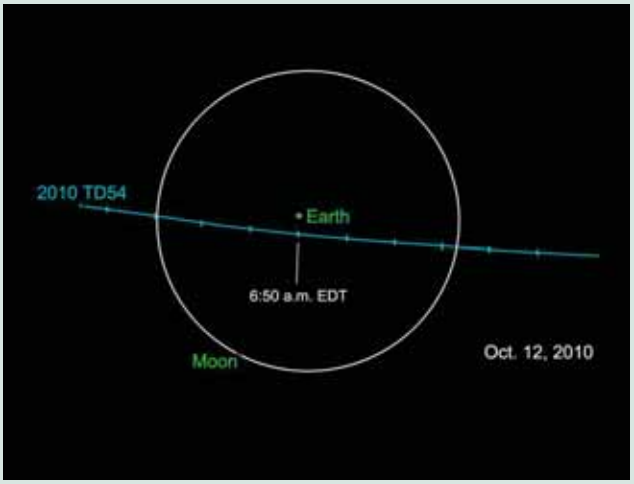
FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Develop missions in support of this Outcome, as demonstrated by completing the Juno Systems Integration Review (SIR).	7SSE3 White	8PS03 Green	9PS2 Green	10PS02 Green
Develop missions in support of this Outcome, as demonstrated by completing the Mars Science Laboratory (MSL) flight hardware builds and flight system assemblies.	7SSE5 Green	8PS05 Green	9PS4 Red	10PS06 Yellow
Develop missions in support of this Outcome, as demonstrated by completing the Mars Atmosphere and Volatile Evolution Mission (MAVEN) Preliminary Design Review (PDR).	None	None	None	10PS08 Green
Demonstrate progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system. Progress will be evaluated by external expert review.	7SSE6 Green	8PS06 Green	9PS8 Green	10PS09 Green

Why NASA did not achieve APG 10PS06: The flight hardware build and flight system assembly of the Sample Analysis at Mars (SAM) instrument were not completed during the designated fiscal year, due to complications in the development of the Wide Range Pump (WRP) components of the instrument. The materials originally specified as the primary component of a high-speed, high-performance bearing proved to be inadequate to provide the necessary performance on the surface of Mars, and alternative bearing materials and components had to be researched and developed.

Plans for achieving 10PS06: The development of the new bearing designs has been completed and implemented, and the finalization of the flight hardware build has resumed. The final flight units are on schedule to be delivered in early December 2010.

Outcome 3C.4: Progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green



Credit: NASA/JPL-Caltech

Just after the close of FY 2010 a team at the NASA-sponsored Catalina Sky Survey north of Tucson, Arizona, discovered that a small asteroid about the size of a car was going to fly past Earth on October 12, shown here in a tracking map. Named 2010 TD54, the asteroid passed within 27,960 miles of Earth, measuring from the center of Earth outward. Had it entered Earth's atmosphere, it would have burned up long before reaching the ground.

Keeping count of near-Earth objects

Near-Earth objects, asteroids and comets that pass close to or impact with Earth, pose a threat to property, the environment, and even life itself. At the same time, they hold great scientific interest because they represent relatively unchanged debris from the solar system formation process some 4.6 billion years ago. They may carry with them ice and the building blocks of life. NASA funds teams that search for and catalogue near-Earth objects for both planetary protection and scientific purposes.

In FY 2010, asteroid search teams found 19 asteroids larger than one kilometer with orbits coming within Earth's vicinity. The search teams classify the finds as either larger or smaller than one kilometer because asteroids larger than one kilometer would cause global climatic changes. In addition, the teams also found 817 smaller asteroids, bringing the total number of known asteroids to 7,235. One additional Earth-approaching comet also was found this year. High precision orbit predictions computed by NASA's Jet Propulsion Laboratory show that none of these objects are likely to hit Earth in the next century. However, 1,142 (of which 149 are larger than one kilometer in diameter) are in orbits that could become a hazard in the more distant future and warrant monitoring. NASA's goal is to find 90 percent of objects larger than one kilometer. Taking all the new discoveries into account, 818 near-Earth asteroids larger than one kilometer have been found to date, meaning the teams have found as many as 87 percent of the total existing objects.

More on NASA's Near Earth Object Program can be found at *http://neo.jpl.nasa.gov/*.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Develop missions in support of this Outcome, as demonstrated by completing the Mars Science Laboratory (MSL) flight hardware builds and flight system assemblies.	7SSE5 Green	8PS05 Green	9PS4 Red	10PS06 Yellow
Demonstrate progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence. Progress will be evaluated by external expert review.	7SSE8 Green	8PS08 Green	9PS9 Green	10PS10 Green
Develop missions in support of this Outcome, as demonstrated by completing the first flight test of a warm gas lander testbed, to be used in support of lunar lander developments.	None	None	9PS10 Green	10PS12 Yellow

Why NASA did not achieve APG 10PS06: The flight hardware build and flight system assembly of the Sample Analysis at Mars (SAM) instrument were not completed during the designated fiscal year, due to complications in the development of the Wide Range Pump (WRP) components of the instrument. The materials originally specified as the primary component of a high-speed, high-performance bearing proved to be inadequate to provide the necessary performance on the surface of Mars, and alternative bearing materials and components had to be researched and developed.

Plans for achieving 10PS06: The development of the new bearing designs has been completed and implemented, and the finalization of the flight hardware build has resumed. The final flight units are on schedule to be delivered in early December 2010.

Why NASA did not achieve APG 10PS12: The first integrated test of the Robotic Lunar Lander Development Project warm-gas test bed has been delayed primarily due to engineering analysis which required a re-design of the composite structure decks and subsequent fabrication delays of the structure.

Plans for achieving 10PS12: The redesign is complete, and the vendor fabrication of the composite decks was completed at the end of October 2010. A revised schedule for the first integrated test is expected in early FY 2011. In the meantime, good progress has been made with other key subsystems for the warm-gas test bed. For example, the project has successfully integrated the flight software, ground software, and guidance and control algorithms with the avionics and the sensors, and most notably, the propulsion system successfully completed acceptance testing. The first free-flight test is expected by March/April 2011.

Sub-Goal 3D

Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

Summary of Ratings for Sub-Goal 3D	
4 Outcomes	9 APGs
Green = 4	Green = 7
Yellow = 0	Yellow = 2
Red = 0	Red = 0
White = 0	White = 0

FY 2010 Cost of Performance (Dollars in Millions)
$1,654.2

Using explorer missions and space-based telescopes, NASA enables research to understand the structure, content, and evolution of the universe. This research provides information about humankind's origins and the fundamental physics that govern the behavior of matter, energy, space, and time, and aids the search for life elsewhere in the universe. NASA-supported researchers try to answer three main questions:

How does the Universe work?

The Physics of the Cosmos Program contains missions that explore the extreme physical conditions of the universe, from black holes to dark energy. The Chandra X-ray Observatory, the third of NASA's Great Observatories, is joined by one of NASA's most recently launched missions, the Fermi Gamma-ray Space Telescope, as the main research instruments for this program.

How did we get here?

The Cosmic Origins program comprises projects that enable the study of how stars and galaxies came into being, how they evolve, and ultimately how they end their lives. The Hubble Space Telescope, Spitzer Space Telescope, and the Stratospheric Observatory for Infrared Astronomy (SOFIA) all support this research area.

Are we alone?

The Exoplanet Exploration program focuses on advancing scientific understanding of planets and planetary systems around other stars known as extrasolar planets, or simply exoplanets, with the goal of detecting habitable, Earth-like planets around other stars, determining how common such planets are, and searching for indicators that they might harbor life. The Kepler mission, launched in March 2009, is NASA's first dedicated Exoplanet Exploration mission.

Astrophysics also contributes to two crosscutting programs: the Explorer Program and Astrophysics Research. In partnership with the Heliophysics Division, missions under the Explorer Program provide opportunities for innovative science and fill the scientific gaps between the larger missions. For example, the Wide-field Infrared Survey Explorer (WISE), launched in December 2009, has surveyed the entire sky in the near-to-mid infrared, to find

Photo above: Ball Aerospace optical technician Scott Murray inspects six primary mirror segments, critical elements of the James Webb Space Telescope, prior to cryogenic testing in the X-ray and Cryogenic Facility at NASA's Marshall Space Flight Center. (Credit: NASA/D. Higginbotham)

the brightest, most distant infrared galaxies and the faintest stars in the solar neighborhood. Sponsored research programs prepare for the next generation of missions, through both theoretical research and applied technology investigations. They also exploit data from current missions and use suborbital science investigations to advance NASA science goals. Suborbital missions, an integral part of the research and analysis program, include sounding rocket, and balloon campaigns which provide ancillary measurements, demonstrate measurement technologies, and train future mission Principal Investigators and students.

Benefits

NASA's astrophysics missions, particularly the three Great Observatories: the Hubble Space Telescope, the Spitzer Space Telescope, and the Chandra X-ray Observatory, have provided researchers with new ways of looking at the universe so that they can expand knowledge about cosmic origins and fundamental physics. The study of the universe benefits the Nation's scientific research community by focusing research and advanced technology developments on optics, sensors, guidance systems, and propulsion systems. Some of these new and improved technologies enable ground-breaking capabilities, which are then available to both the commercial and defense sectors.

Stunning images produced from Astrophysics, operating missions continue to inspire the public, revealing the beauty of our universe and the science behind those images. The striking images from these observatories also are educational tools to help spark student interest in science, technology, engineering, and mathematics and serve to prominently illustrate the role of the United States in scientific exploration. NASA provides the tools to translate the science for the classroom and other learning venues in ways that meet educator needs.

Risks to Achieving Sub-Goal 3D

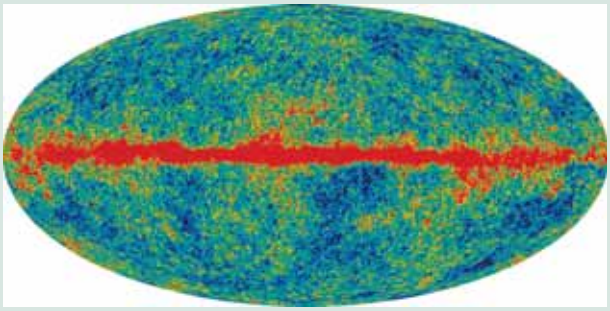
Of primary concern for the Astrophysics Division is the projected increased cost and schedule for the development of the James Webb Space Telescope (JWST). Because its annual budget is a substantial fraction of the Division budget, schedule delays and cost overruns on JWST could significantly impact the Division's ability to respond to the National Research Council's Astro2010 Decadal Survey.

The reduced mission frequency resulting from rising mission costs also impacts the systems approach to Astrophysics. NASA is aggressively exploring options to maintain a vital Explorers flight program. With the October 2010 release of the Explorer AO, the program has taken a vital step toward maintaining an appropriate mix of small and large missions.

Finally, the Astrophysics Division, along with NASA's other Science divisions, continues to be concerned about the increased cost and reduced availability of expendable launch vehicle (ELV) options. The lack of reliable and affordable launch vehicle options may impair the Division's ability to sustain a scientifically and programmatically balanced portfolio during the next decade. Over the course of the last decade, the Delta II has been the workhorse for launching many robotic mid-sized spacecraft. Without this option, NASA has access only to costlier evolved ELVs (Delta IV, Atlas V). Possible cost growth in the evolved ELV class is an additional source of concern. These problems cannot be avoided until new commercial launch vehicles become available, potentially reducing the cost of launching missions.

Outcome 3D.1: Progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green



Credit: NASA/WMAP Science Team

WMAP imaged fluctuations of the cosmic microwave background radiation at 94 GHz as to produce this full-sky temperature map. The color scale is +-200 microKelvin. The red stripe in the middle is emission from our the Milky Way galaxy. WMAP was designed to operate for only four years, but because of flawless operations and excellent science yield, NASA extended the mission.

An aging mission makes discoveries at the earliest moments of the universe

In January 2010, the Wilkinson Microwave Anistropy Probe (WMAP) team celebrated the mission's seventh birthday by publishing the accumulated, compelling results about the origin and destiny of the universe.

The satellite is observing a radiation that is a relic remnant from the Big Bang called the cosmic microwave background radiation. One of the key predictions of the Big Bang model is that most of the helium in the universe was synthesized in the hot early universe only a few minutes after the Big Bang. Previously, scientists studied old stars to infer the helium abundance before there were stars. WMAP data, in combination with other experiments, show the effects of helium in the microwave patterns on the sky indicating the presence of helium long before the first stars formed.

The team also detected in the data signatures of the inflationary expansion of the universe that is believed to have occurred at the beginning of time. According to inflationary models, intensity fluctuations of the relic radiation should be more intense over large patches of the sky compared to those on small patches. This agrees with the data.

The WMAP results also affect understanding of fundamental physics by limiting the number of neutrino-like particles in the universe. Neutrinos are nearly massless elementary particles that move at or near the speed of light. They permeate the universe in large quantity but they interact very weakly with atomic matter. How many such particle species existed in the early universe has been an open question in physics. WMAP data now limits the number of such species to less than six.

More WMAP science results are available at *http://map.gsfc.nasa.gov/news/*.

NASA's Fermi lifts the fog

A new study of the uniform fog of gamma rays from sources outside the Milky Way galaxy shows that less than a third of the emission arises from what astronomers considered the most likely suspects—supermassive black hole-powered jets from active galaxies.

The sky glows in gamma rays even far away from bright sources, such as pulsars and gas clouds within the Milky Way galaxy or the most luminous active galaxies. According to the conventional explanation, this background glow represents the accumulated emission of a vast number of active galaxies that are simply too faint and too distant to be resolved as discrete gamma-ray sources. Thanks to NASA's Fermi Gamma-ray Space Telescope, scientists now know this is not the case.

Because of its breakthrough capabilities, the Fermi Large Area Telescope (LAT) maps the entire gamma-ray sky continuously, looking ever more deeply into the universe and tracking all sources as they vary in intensity. Active galaxies possess central black holes containing millions to billions of times the Sun's mass. As matter falls toward the black hole, some of it becomes redirected into jets of particles traveling near the speed of light. These particles can produce gamma rays.

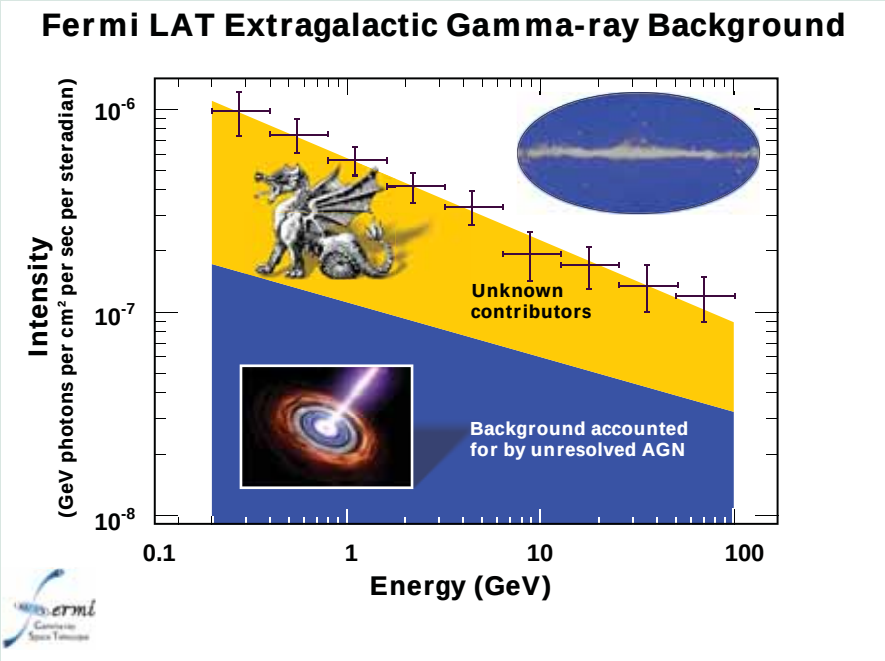
There also are other potential sources for extragalactic gamma-ray background: particle acceleration occurring in normal star-forming galaxies is a strong contender; particle acceleration during the final assembly of the large-scale structure observed today, for example, where clusters of galaxies are merging together; or dark matter, the

mysterious substance that neither produces nor obscures light but whose gravity corrals normal matter. Dark matter may be a type of as-yet-unknown subatomic particle. If that's true, dark matter particles should interact with each other in a way that produces gamma rays. Improved analysis and extra sky exposure will enable scientists to address these potential contributions.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Demonstrate progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity. Progress will be evaluated by external expert review.	7UNIV1 Green	8AS01 Green	9AS1 Green	10AS01 Green
Develop missions in support of this Outcome, as demonstrated by completing the NuSTAR Critical Design Review (CDR).	None	None	None	10AS02 Green
Conduct the flight program in support of this Outcome, as demonstrated by achieving mission success criteria for Fermi.	None	None	None	10AS04 Green

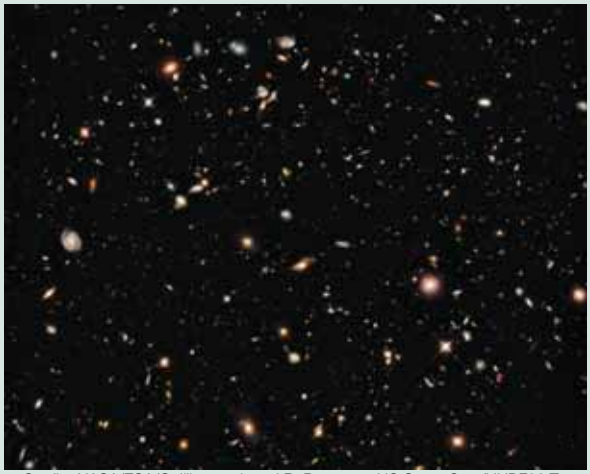
Centuries ago map makers marked distant regions with, "Here be dragons," warning explorers that they would be traveling into the unknown. Astronomers using NASA's Fermi telescope find themselves in the same situation as they study the ever-present fog of gamma rays from sources outside the galaxy. The Fermi data invalidated a once-popular explanation for the extragalactic gamma-ray background, showing that jets from active galaxies play only a minor role in producing the emission.

Credit: NASA/DOE/Fermi LAT Collaboration



Outcome 3D.2: Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green



Credit: NASA/ESA/G. Illingworth and R. Bouwens, UC Santa Cruz/HUDF09 Team

This image was taken in late August 2009 with Hubble's Wide Field Camera 3. The faintest and reddest objects are galaxies that correspond to "look-back times" of about 12.9 to 13.1 billion years ago. These galaxies are much smaller than the Milky Way galaxy and have populations of stars that are intrinsically very blue. This may indicate the galaxies are so primordial that they are deficient in heavier elements and, as a result, are relatively free of dust that reddens light through scattering.

Hubble on the edge of the observable universe

The NASA–European Space Agency Hubble Space Telescope smashed the distance limit for galaxies and uncovered a primordial population of compact and ultra-blue galaxies that have never been seen before. With this data the astronomers have entered uncharted territory ripe for discoveries about young galaxies and galaxy formation.

The deeper Hubble looks into space, the farther back in time it looks, making it a powerful "time machine" that allows astronomers to see galaxies as they were 13 billion years ago, just 600 million to 800 million years after the Big Bang. At least one of the newly discovered galaxies lies beyond a redshift of 8.5, or 13.1 billion years ago. These discoveries push back the known time of formation of the first galaxies to less than 600 million years after the Big Bang. The deep observations also demonstrate the progressive buildup of galaxies and provide further support for the hierarchical model of galaxy assembly where small objects merge to form bigger objects over a smooth and steady, but still dramatic, process of collision and agglomeration, as these small building blocks fuse into the larger galaxies known today. In the future, the much more powerful JWST will allow astronomers to study the detailed nature of such primordial galaxies and discover many more even farther away. The recently completely WISE mission will produce a catalog of rich sources on which JWST will conduct follow-up observations.

More on this story is available at *http://hubblesite.org/newscenter/archive/releases/2010/02/full/*.

Fermi closes in on source of cosmic rays

New images from NASA's Fermi Gamma-ray Space Telescope show where supernova remnants emit radiation a billion times more energetic than visible light. The images bring scientists an important step closer to solving the mystery of the source of some of the most energetic particles in the universe—cosmic rays.

Cosmic rays are part of the most extreme environments of the dynamic and diverse universe, where nature harnesses incredible energies that form black holes, forge galaxies, and compose dark matter. Cosmic rays consist mainly of protons that move through space at nearly the speed of light. In their journey across the galaxy, the particles are deflected by magnetic fields. This scrambles their paths and masks their origins.

In 1949, the Fermi telescope's namesake, physicist Enrico Fermi, suggested that the highest-energy cosmic rays were accelerated in the magnetic fields of gas clouds. In the decades that followed, astrophysicists showed that supernova remnants are the best candidate sites in the galaxy for this process. Young supernova remnants seem to possess both stronger magnetic fields and the highest-energy cosmic rays. Stronger fields can keep the highest-energy particles in the remnant's shock wave long enough to speed them to the energies observed. The Fermi telescope observations show billion-electron-volt (GeV) gamma rays (gamma rays are produced when cosmic rays collide with interstellar gas) coming from places where the remnants are known to be interacting with cold, dense gas clouds. These observations validate the hypothesis that supernova remnants act as enormous accelerators for cosmic particles.

More on this story is available at *http://www.nasa.gov/mission_pages/GLAST/news/cosmic-rays-source.html*.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Demonstrate progress in understanding how the first stars and galaxies formed and how they changed over time into the objects we recognize in the present universe. Progress will be evaluated by external expert review.	7UNIV5 Green	8AS03 Green	9AS3 Green	10AS05 Green
Develop missions in support of this Outcome, as demonstrated by completing the James Webb Space Telescope (JWST) Optical Telescope Element Critical Design Review (CDR).	7UNIV4 Green	8AS04 Green	9AS4 Green	10AS06 Green
Develop missions in support of this Outcome, as demonstrated by completing the first competed Early Science observations on the Stratospheric Observatory for Infrared Astronomy (SOFIA).	None	None	9AS5 Yellow	10AS07 Yellow
Conduct the flight program in support of this Outcome, as demonstrated by achieving mission success criteria for WISE.	None	None	None	10AS08 Yellow

Why NASA did not achieve APG 10AS07: Technical problems with the telescope cavity door actuator on the SOFIA aircraft, due to quality control issues at the vendor of the actuator, led to increased time required for flight testing and certification for open-door flight at the altitude required for early science. NASA worked directly with the vendor to address and resolve the quality control issues.

Plans for achieving 10AS07: Flight testing of the full flight envelope has been completed, and the first image has been acquired by the telescope in flight. The program is currently on track for the first early science observation by December 2010.

Why NASA did not achieve APG 10AS08: WISE has met all of its minimum success criteria and is considered to be a successful mission by both NASA and the science community. WISE has met all of its full mission success criteria, with the exception of the sensitivity requirement in band 4 (23 micrometers). The requirement was to achieve sensitivity of 4 millijansky (mJy) over 95 percent of the sky. The actual achieved sensitivity in band 4 was 4.8 mJy over 95 percent of the sky. The shortfall has an insignificant effect on the scientific productivity of the WISE mission. The loss of sensitivity compromised the ability of WISE to detect objects as faint as those that would otherwise have been seen, especially affecting measurements of galaxies and dusty disks surrounding young stars. Relatively faint galaxies missing in one area were observed elsewhere in the sky, where repeated sky coverage yielded deeper observations. However, an analogous compensation method did not apply to young stars because these objects are located only in certain regions. Consequently, WISE did not observe as many faint dusty disks as had been anticipated.

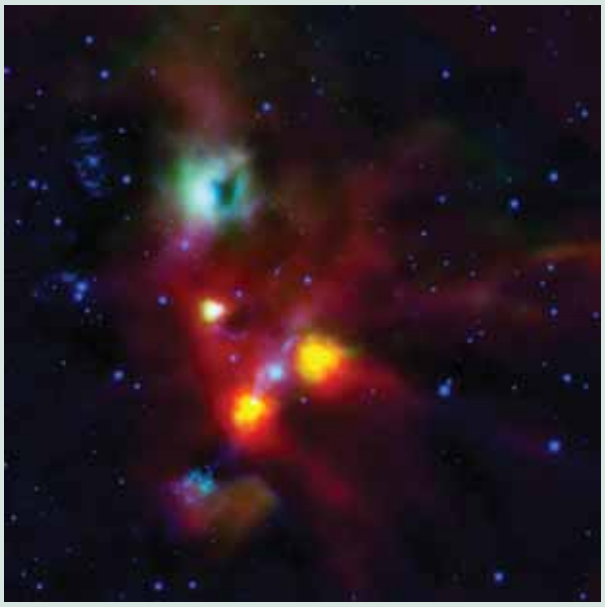
Plans for achieving 10AS08: WISE has completed its mission.

This composite image shows the Cassiopeia A supernova remnant across the spectrum: Gamma rays (magenta) from NASA's Fermi Gamma-ray Space Telescope; X-rays (blue, green) from NASA's Chandra X-ray Observatory; visible light (yellow) from the Hubble Space Telescope; infrared (red) from NASA's Spitzer Space Telescope; and radio (orange) from the Very Large Array near Socorro, New Mexico. Fermi's Large Area Telescope spied GEV gamma rays from Cassiopeia A, which is a youthful 330 years old. Fermi allows astronomers to compare emissions from remnants of different ages and in environments.

Credit: NASA/DOE/Fermi LAT Collaboration, CXC/SAO/JPL-Caltech/Steward/O. Krause et al., and NRAO/AUI

Outcome 3D.3: Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green



Credit: ESA/NASA/JPL-Caltech/Univ. of Toledo

The dark hole seen in the green cloud (NGC 1999) at the top of this image was likely carved out by multiple jets and blasts of radiation. For most of the 20th century, black patches were known to be dense clouds of dust and gas that block light from passing through. Astronomers originally thought the hole was a really dark cloud, but this new infrared picture from Herschel, a European Space Agency mission, and the National Optical Astronomy Observatory on Kitt Peak near Tucson, Arizona, reveals that the dark spot is actually a gap in a "nest" of gas and dust containing fledgling stars. The red, filamentary glow extending through the middle of the image is a cloud of cold, dense gas and dust—the raw material from which new stars are forming. NASA played a key role in the development of two of Herschel's three instruments and will make important contributions to data and science analyses.

Herschel provides glimpse into the end of star-forming processes

The Herschel Space Observatory has made an unexpected discovery: a gaping hole in the clouds surrounding a batch of young stars. The hole has provided astronomers with a surprising glimpse into the end of the star-forming process.

Although astronomers have seen jets and winds of gas streaming from young stars in the past, it has always been a mystery exactly how a star uses the jets to blow away its surroundings and emerge from its birth cloud. For the first time, Herschel may be seeing an unexpected step in this process. A cloud of bright reflective gas known to astronomers as NGC 1999 sits next to a black patch of sky.

Investigating further using ground-based telescopes, astronomers found the same story no matter how they looked. This patch looks black not because it is a dense pocket of gas but because it is truly empty space. Astronomers think that the hole must have been opened when the narrow jets of gas from some of the young stars in the region punctured the sheet of dust and gas that forms NGC 1999. The powerful radiation from a nearby adolescent star may also have helped to clear the hole. Whatever the precise chain of events, it could be an important glimpse into the way newborn stars rip apart their birth clouds.

More on this story is available at *http://www.nasa.gov/mission_pages/herschel/herschel20100511.html*.

Spitzer spies a 'flying dragon' smoldering with secret star birth

NASA's Spitzer Space Telescope has revealed a cosmic cloud shaped like a flying dragon that has a secret burning behind its dark scales. Stars are forming in this cloud, dubbed M17 SWex, about as fast as in a neighboring, dazzling nebula called M17 that is illuminated by giant stars, but no similar stellar behemoths have yet emerged to set the dragon's dusty innards aglow. Astronomers believe that they have captured this cloud in a very early phase of star formation, before its most massive stars have ignited. A wave of massive star formation, possibly caused by the crossing of a grand spiral arm of the Milky Way galaxy, appears to be rippling through the M17 complex. This surge has not yet reached the beastly cloud, establishing M17 SWex as a compelling place to explore the origins of massive stars. Spitzer's infrared vision has shown that M17 and M17 SWex are some of the busiest star-making factories in the Milky Way. Spitzer has detected the infrared light given off by heated dust in M17 SWex,

signifying 488 newly forming stars, most of which have grown disks of material around their middles that may give rise to planets. More than 200 of these younglings will become class B stars, larger and hotter than the Sun. Conspicuously absent from M17 SWex, however, are class O stars, the bluest, hottest, and biggest of new stars. Although relatively rare in the cosmos, O stars are what light up neighboring M17, and given all the star-forming material in M17 SWex, these behemoths should be on the scene there as well. Their absence hints that these colossal stars may form later, perhaps needing an extra impetus to nudge them into existence.

More on this story is available at *http://www.spitzer.caltech.edu/news/1143-feature10-09-Spitzer-Spies-a-Flying-Dragon-Smoldering-with-Secret-Star-Birth*.

Credit: NASA/JPL-Caltech/M. Povich, Penn State Univ.

A black, dragon-shaped cloud of dust, M17 SWex, seems to fly out from a bright explosion in this infrared light image (top) from Spitzer, a creature that is entirely cloaked in shadow when viewed in the visible part of the spectrum (bottom). While it is forming stars at a furious rate, it has not yet spawned the most massive type of stars, O stars, that light M17 in the lower center of both images. At the far left of the field lies a giant "bubble" blown by blue O stars, aged some two to five million years. Meanwhile, the budding stars in M17 SWex have not yet celebrated their one millionth birthdays—truly infants in the stellar sense.

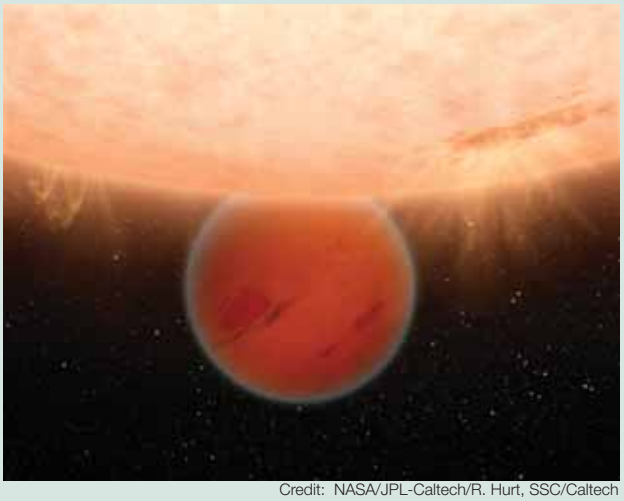
FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Develop missions in support of this Outcome, as demonstrated by completing the James Webb Space Telescope (JWST) Optical Telescope Element Critical Design Review (CDR).	7UNIV4 Green	8AS04 Green	9AS4 Green	10AS06 Green
Develop missions in support of this Outcome, as demonstrated by completing the first competed Early Science observations on the Stratospheric Observatory for Infrared Astronomy (SOFIA).	None	None	9AS5 Yellow	10AS07 Yellow
Demonstrate progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems. Progress will be evaluated by external expert review.	7UNIV6 Green	8AS06 Green	9AS6 Green	9AS09 Green

Why NASA did not achieve APG 10AS07: Technical problems with the telescope cavity door actuator on the SOFIA aircraft, due to quality control issues at the vendor of the actuator, led to increased time required for flight testing and certification for open-door flight at the altitude required for early science. NASA worked directly with the vendor to address and resolve the quality control issues.

Plans for achieving 10AS07: Flight testing of the full flight envelope has been completed, and the first image has been acquired by the telescope in flight. The program is currently on track for the first early science observation by December 2010.

Outcome 3D.4: Progress in creating a census of extrasolar planets and measuring their properties.

FY07	FY08	FY09	FY 2010
Yellow	Green	Green	Green



Credit: NASA/JPL-Caltech/R. Hurt, SSC/Caltech

The unusual, methane-free world GJ 436b is partially eclipsed by its star in this artist's concept. Scientists writing about the planet in the April 22, 2010, issue of Nature said that they were puzzled by planet's atmosphere because previous models showed that the carbon should have been in the form of methane. GJ 436b, located 33 light-years away in the constellation Leo, is providing data on faraway planets that will show what is really going on in their atmospheres.

Spitzer discovers a planet is missing an ingredient

NASA's Spitzer Space Telescope has discovered something odd about a distant planet: The planet lacks methane, an ingredient common to many of the planets in Earth's solar system. The discovery brings astronomers one step closer to probing the atmospheres of distant planets the size of Earth. Eventually, a larger space telescope could use the same kind of technique to search smaller, Earth-like worlds for methane and other chemical signs of life, such as water, oxygen and carbon dioxide. The methane-free planet, called GJ 436b, is about the size of Neptune, making it the smallest distant planet that any telescope has successfully analyzed. Any world with the common atmospheric mix of hydrogen, carbon, and oxygen, and a temperature up to 1,000 Kelvin (1,340 degrees Fahrenheit) is expected to have a large amount of methane and a small amount of carbon monoxide. Surprisingly, Spitzer observations found just the opposite—carbon monoxide but no methane.

For more on this story go to *http://spitzer.caltech.edu/news/1110-ssc2010-05--This-Planet-Tastes-Funny-According-to-Spitzer-Telescope*.

Evolution of an unusual multi-planet system

Almost all of the planets within Earth's solar system orbit within the same plane, the natural byproduct of a disk of gas and dust around a young star collapsing down to form planets. This follows the astronomers' theories of how multi-planet systems evolve. In May 2010, astronomers reported the discovery of a planetary system that impacts these theories—a planetary system way out of tilt, where the orbits of two planets are at a steep angle to each other.

For just over a decade, astronomers have known that three Jupiter-sized planets (designated Upsilon Andromedae b, c, and d) orbit the yellow-white star Upsilon Andromedae. Combining data from the Hubble Space Telescope and ground-based telescopes, astronomers have determined the exact masses of Upsilon Andromedae c and d, and much more startling, found that the orbits of planets c and d are inclined by 30 degrees with respect to each other. This research marks the first time that astronomers have measured the "mutual inclination" of two planets orbiting another star. They have also uncovered hints that a fourth planet, e, orbits the star much farther out. Several different gravitational scenarios could be responsible for the surprisingly inclined orbits, including interactions occurring from the inward migration of planets, the ejection of other planets from the system through planet-planet scattering, or disruption from the parent star's binary companion star. Further research is required to understand these observations, but they already offer exciting insight into the creation and evolution of planetary systems.

For more on this story go to *http://hubblesite.org/newscenter/archive/releases/2010/17/full/*.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Demonstrate progress in creating a census of extra-solar planets and measuring their properties. Progress will be evaluated by external expert review.	7UNIV7 Green	8AS07 Green	9AS7 Green	10AS10 Green

Sub-Goal 3E

Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.

Summary of Ratings for Sub-Goal 3E	
5 Outcomes	13 APGs
Green = 4	Green = 10
Yellow = 1	Yellow = 3
Red = 0	Red = 0
White = 0	White = 0

FY 2010 Cost of Performance (Dollars in Millions)
$697.0

NASA research continues to contribute directly to aeronautics breakthroughs that impact public safety and the Nation's economy. A key enabler for American commerce and mobility, U.S. commercial aviation is vital to the Nation's well-being. As NASA's lead organization for aeronautics research, NASA's Aeronautics Research Mission Directorate (ARMD) conducts cutting-edge research to generate the innovative concepts, tools, and technologies that will enable revolutionary advances in future aircraft as well as they airspace through which they fly.

Each of NASA's five aeronautics programs plays a significant role in addressing Sub-goal 3E:

- The Fundamental Aeronautics Program seeks to continually improve technology that can be integrated into today's state of the art aircraft, while enabling game-changing concepts for future generations of aircraft technologies such as Hybrid Wing Body airframes which promise reduced drag (thus improving fuel burn), and open rotor engines which offer the promise of 20 percent fuel burn reduction compared to today's aircraft. We are addressing key challenges to enable new rotorcraft and supersonic aircraft, and conducting foundational research on hypersonic flight at seven times the speed of sound. Another key research goal is to enable the use of synthetic and bio-derived alternatives to the petroleum-derived fuel that all jet aircraft have used for the last 60 years.
- The Aviation Safety Program conducts research to ensure that aircraft and operational procedures maintain the high level of safety which the American public has come to count on. We perform research in safety issues that span aircraft operations, air traffic procedures, and environmental hazards. This research seeks to not only improve the intrinsic in-flight and on-ground safety of current and future aircraft, but to overcome technological barriers that would otherwise constrain the full realization of the next generation air transportation system.
- The Airspace Systems Program aims to improve efficiency and reduce environmental impact of aviation through improved air traffic management concepts and technologies covering gate-to-gate operations on the airport surface, on runways, in the dense terminal area, and in the many en route sectors of the national airspace. In order to achieve these improvements, safe and efficient operational concepts, technologies, and procedures must be developed, validated, and certified for operational use.

Photo above: Ice forms on a vertical stabilizer in NASA Glenn Research Center's Icing Research Tunnel. (Credit: NASA)

- The Aeronautics Test Program (ATP) manages the testing capabilities of one of the largest, most versatile and comprehensive set of research facilities in the United States. These facilities are used by NASA programs, other federal agencies, and the private sector to test and evaluate research concepts and technologies. ATP manages current facilities and makes strategic investments to ensure that both NASA and national interests in the public and private sectors have ready access to comprehensive testing in state-of-the-art ground test facilities and with flight research assets.
- The Integrated Systems Research Program (ISRP) evaluates and selects the most promising concepts emerging from our foundational research programs for integration at the systems level. ISRP will test integrated systems in relevant environments to demonstrate that the combined benefits of these new concepts are in fact greater than the sum of their individual parts. By focusing on technologies that have already proven their merit at the foundational level, this program will help transition those technologies more quickly to the aviation community, as well as inform future foundational research needs. ISRP will also advance capabilities to design and integrate complex aviation systems.

Benefits

NASA's aeronautics program ensures long-term focus in fundamental research in traditional aeronautical disciplines and relevant emerging fields, as well as integration into multidisciplinary system-level capabilities for broad application. This approach will enable revolutionary change to both the airspace system and the aircraft that fly within it, ultimately leading to a safer, more environmentally friendly, and more efficient national air transportation system. In order to accomplish this research, ARMD reaches out to the greater aeronautics community through the NASA Research Announcement (NRA) process and fosters collaborative partnerships with the academic and private sector communities while also providing support for science, technology, engineering, and math departments. By directly connecting students with NASA researchers and our industrial partners, NASA aeronautics research helps future workforce needs by inspiring students to choose a career in the aerospace industry.

Risks to Achieving Sub-Goal 3E

NASA pursues challenging, cutting-edge technology advances and aeronautics research goals that are inherently high risk. Although ARMD may not reach some planned program goals due to this high technical risk, lessons learned nevertheless advance the state of knowledge for NASA programs. The Agency and the Nation are thus able to make informed decisions on committing research resources to better ensure the achievement of national goals and objectives.

NASA's aeronautics partnerships provide many benefits, but they also introduce external dependencies that influence schedules and research output. In particular, research may depend on contributions from partner agencies to conduct validation studies and to implement technologies once transitioned. NASA mitigates these risks through continual coordination with its partners in academia, industry, and other Federal agencies to ensure that the Agency is moving forward on the right challenges and improving the transition of research results to users.

Outcome 3E.1: By 2016, identify and develop tools, methods, and technologies for improving overall aircraft safety of new and legacy vehicles operating in the Next Generation Air Transportation System (projected for the year 2025).

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA

The Integrated Intelligent Flight Deck includes systematic incorporation of integrated displays and interactions, decision-support functions, information management and abstraction, and appropriate human/automation function allocations. The future flight deck system is aware of the vehicle, operator, and airspace system state and responds appropriately. The system senses internal and external hazards, evaluates them, and provides key information to facilitate timely and appropriate responses.

NASA explores how aircraft age

In FY 2010, the Aging Aircraft and Durability Project developed an innovative method for modeling the effects of water penetrating epoxy matrix resins (a component of advanced structural composites) and their ability to adhere to each other.

Aircraft aging is a significant national issue. For economic reasons, commercial airline carriers and the Department of Defense (DoD) are flying their vehicles longer, often exceeding the original design service life of the vehicles. The average age of the commercial fleet, which reduced after 9/11 as older vehicles were parked, is increasing, particularly in the wide-body class. The DoD is replacing its fleet at less than half the rate required to even maintain the current average age.

Emerging civilian and military aircraft are introducing advanced material systems, fabrication techniques, and structural configurations for which there is very limited service history, and there is concern over the ability to ensure continued airworthiness of these aircraft over their life cycles. Simulation results demonstrated that this new modeling technique provides qualitative predictive capability for the changes in surface energy of epoxy matrix resins that can affect the adhesion characteristics of bonded interfaces, such as those encountered in aircraft structural assemblies.

Understanding how moisture present in the epoxy matrix resins changes the surface energy at the interface of bonded areas can aid in the development of new epoxy chemistries or surface treatments that resist the negative effects of moisture penetration to provide more durable and reliable bonded assemblies.

NASA experiments support more capable and safer flight deck systems

The Integrated Intelligent Flight Deck Project published flight deck guidelines, information, and display requirements that meet NextGen operational concept needs. The project based these guidelines on data collected via human-in-the-loop studies in flight deck simulators that replicated the higher traffic densities and four-dimensional trajectory based operations and equivalent visual NextGen-based environments, utilizing advanced flight deck data communication, display, indication, and alerting technologies. NASA also conducted experiments with flight crews and controllers utilizing various levels of flight-deck automation. By providing these results to industry-wide and FAA-sponsored technical committees, NASA helps to inform and generate authorized operational requirements and certification standards for new technologies and procedures.

NASA improves aircraft safety

The Integrated Resilient Aircraft Control Project, which conducts research to advance the state of aircraft flight control to provide onboard control resilience for ensuring safe flight in the presence of unforeseen, adverse conditions, developed a tool suite that would be used to locate failure points in the flight envelope for a chosen adaptive control system and a set of adverse events. The suite is an integrated software package designed to efficiently analyze dynamic systems subject to uncertainty and offers several complementary methods for performing

a variety of uncertainty quantification tasks. Details of the dynamics involved in an aircraft loss of control situation are required to better understand how a system can best regain control without further exacerbating the situation.

Results of an investigation using the integrated software package demonstrated confidence levels as good as what can be achieved using direct Monte-Carlo simulation techniques with a factor of ten reduction in computing time over direct Monte Carlo techniques. The Integrated Vehicle Health Management Project developed an advanced hybrid diagnostic system for electromechanical actuators (EMA) that covers a wide variety of faults typical to this type of actuator. The system combines both qualitative and quantitative diagnostic approaches to achieve low false positive/false negative detection rates and a high accuracy of diagnostic output. After conducting validation experiments using 320 different nominal and fault scenarios, the results showed very low rates for false positive and false negative fault detections and over 95 percent diagnostic accuracy. As EMAs become increasingly applied to such aircraft critical roles as control surface actuation, having a reliable diagnostic system monitoring their performance becomes essential. The work paves the way for development of more capable EMA health management systems.

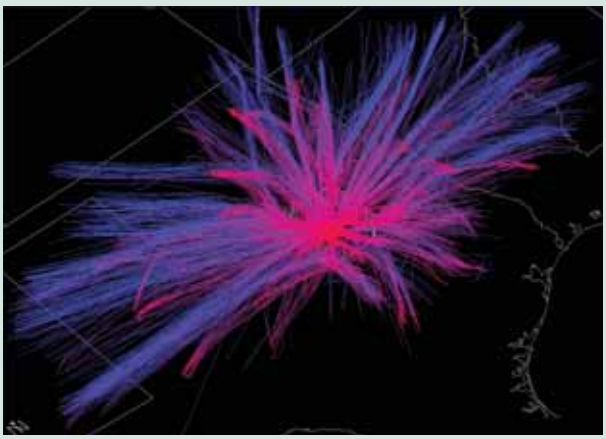
FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Using 2008 as a baseline, demonstrate, on a representative current-generation electromechanical system test bed, improved IVHM via Bayesian methods and/or models for varying operating conditions and demonstrate fault detection/diagnosis on at least three faults types and examine tradeoff between accuracy and diagnosis time.	7AT1 Green	8AT04 Green	9AT1 Green	10AT01 Green
Develop an atomistically-based model capable of predicting within 25% the degradation caused by environmental effects on interfaces in selected polymer matrix composite materials.	7AT01 Green	None	9AT02 Green	10AT02 Yellow
Deliver and validate through analysis flight deck guidelines, information, and display requirements that meet NextGen operational needs as established in 2007 baseline assessment, and without a measurable increase to safety risk.	7AT1 Green	8AT02 Green	9AT3 Green	10AT03 Green
Develop a tool suite that provides an order of magnitude reduction in analysis time over current Monte-Carlo simulation methods that would be used to locate failure points in the flight envelope for a chosen adaptive control system and a set of adverse events.	7AT1 Green	None	9AT4 Green	10AT04 Green

Why NASA did not achieve APG 10AT02: This effort attempted to significantly push the state-of-the-art in atomistic-based computational modeling, and application of such models to predict the effects of aging of epoxy matrix resins used on commercial aircraft. The computational model that was developed predicted a reduction in surface energy over time, which is consistent with physical aging phenomenon reported in the literature. While the surface energy predictions differed somewhat from the measured values, experiments on lap shear specimen data for both surface energy and lap shear strength validated the predicted trends. Due to variability in computational and experimental results, it was not possible to validate the computational model for accurate quantitative prediction of physical aging to the performance level defined in the green success criteria.

Plans for achieving 10AT02: The activity as defined in the APG is complete. The performance level defined in the yellow success criteria was achieved. Since this was a "stretch-goal" no plans exist to continue to attempt to reach the absolute accuracy reflecting a green success criteria. However, the results obtained will inform future research in atomistic computational modeling. Further, successful prediction of the trends observed in experiments show that atomistic computational modeling may indeed be a valuable tool to guide new material development for improved durability.

Outcome 3E.2: By 2016, develop and demonstrate future concepts, capabilities, and technologies that will enable major increases in air traffic management effectiveness, flexibility, and efficiency, while maintaining safety, to meet capacity and mobility requirements of the Next Generation Air Transportation System.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green



Credit: NASA

This flower-shaped image shows flights in and out of the Dallas–Ft. Worth International Airport. The red lines indicate low-altitude flights and the blue line high-altitude flights.

NASA continues research to improve air traffic control

NASA researchers at Ames and Langley Research Centers conducted a coordinated set of simulations of advanced NextGen concepts to investigate allocation of separation functions between airborne and ground-based systems and human operators and automation. It is fully expected that the future national airspace system must manage, at any given time, a much larger number of flights requiring separation capability resident in both the ground control facilities and cockpit.

These experiments, which simulated the flow of air traffic across eight air traffic control sectors in 14 operational scenarios, conducted an initial assessment of the performance of those capabilities. These simulations investigated: use of ground-based automation for conflict detection and resolution, airborne surveillance-enabled operation for self-separation by the flight-deck, and advanced trajectory-based operations at approximately twice the current maximum capacity, with integrated metering, weather, and conflict avoidance. This simulation also addressed the NextGen High Value Focus Area of Air/Ground and Human/Machine Functional Allocation as identified by the Joint Planning and Development Office (JPDO). The integrated simulations illustrated significant cross-center collaboration, had unprecedented commonality in experiment designs for comparison of disparate concepts, and matured both ground-based and flight-deck conflict detection and resolution algorithms and procedures.

The participants supporting these simulations included 48 domestic and international airline pilots, and 20 active FAA supervisors and retired controllers. The scenarios studied one and a half to two times the traffic density, time-based metering, and trajectory change events, collecting 264 pilot-hours of airborne based and 300 hours of ground based simulation data along with extensive questionnaire data.

Common scenarios represented a significant increase in airspace demand over current operations. Where comparisons were possible with current operations, no substantial differences in performance or operator acceptability were observed. Mean schedule conformance and flight path deviation were considered adequate for both approaches. Conflict detection warning times and resolution times were mostly adequate. Some situations, designed to stress the concepts and assess safety implications, were identified in which safety was compromised and/or workload was rated as being unacceptable in both experiments. These findings will be used to enhance the algorithms and future simulation designs to address the NextGen automation needs while maintaining safety and reducing workload.

This simulation is the first in a series of culminating simulations of advanced NextGen concepts to investigate allocation of separation functions between airborne and ground-based systems and human operators and automation.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Conduct simulations of automated separation assurance with sequencing, spacing, and scheduling constraints.	None	8AT05 Green	9AT5 Green	10AT05 Green
Determine the feasibility and benefits of one or more candidate Multi-Sector Planner concepts.	None	None	None	10AT06 Green
Produce a report on the human-in-the-loop simulation and model results for the Denver Field Trial.	None	None	None	10AT14 Green

NASA in the Spotlight

NASA Helps Make Helicopters Safer

How do you make a helicopter safer to fly? First you crash one.

In December 2009, NASA aeronautics researchers recently dropped a small helicopter from a height of 35 feet to see whether an expandable honeycomb cushion called a deployable energy absorber could lessen the destructive force of a crash. On impact, the helicopter's skid landing gear bent outward, but the cushion attached to its belly kept the rotorcraft's bottom from touching the ground. Four crash test dummies along for the ride appeared only a little worse for the wear. The test conditions imitated what would be a relatively severe helicopter crash. They recycled the helicopter and dropped it again in 2010, but without the deployable energy absorber attached, in order to compare the results.

For more on this story go to *http://www.nasa.gov/topics/aeronautics/features/helo-droptest.html*.

Photo above: Researchers at NASA's Langley Research Center are testing the deployable energy absorber with the help of a helicopter donated by the Army, crash test dummies from the Applied Physics Laboratory in Laurel, Maryland, and a 240-foot-tall structure once used to teach astronauts how to land on the Moon. (Credit: NASA/S. Smith)

Outcome 3E.3: By 2016, develop multi-disciplinary analysis and design tools and new technologies, enabling better vehicle performance (e.g., efficiency, environmental, civil competitiveness, productivity, and reliability) in multiple flight regimes and within a variety of transportation system architectures.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA

This artist's concept shows a truss-braced wing (TBW), or strut-braced wing (SBW) aircraft. Research results suggest an SBW can reduce fuel weight by 15 percent and a TBW by almost 20 percent due to reduced drag.

NASA's Fundamental Aeronautics Program (FAP) in ARMD conducts long-term foundational research and technology development in all flight regimes to address major national challenges of next generation and future air transportation systems. These advanced air transportation systems demand environmentally sensible aerospace technologies that demonstrate significantly better performance and higher fuel efficiencies, and the use of alternative fuels, to mitigate the vexing problem of noise and emission. To meet these and other important national challenges, FAP, along with industry and university partners, is focusing on developing revolutionary technologies, tools and capabilities to enable dramatic changes in air vehicle design and propulsion systems for vehicles across all flight speed regimes. A particular class of these advanced air vehicle technologies for airframe and propulsion concepts, and other enabling complementary technologies are targeted for entry into commercial service in the N+3 or 2030–2035 timeframe resulting from fundamental research conducted now.

Concept studies guide the way to the future of aeronautics technologies

To achieve this goal, FAP conducts both in-house cross-cutting and foundational research through two of its four projects: the Subsonic Fixed Wing (SFW) Project and the Supersonics (SUP) Project, as well as with industry and academia by means of the NASA Research Announcement (NRA) procurement vehicle in a time-phased approach. The primary objective of the Phase I and Phase II NRA solicitations are to stimulate thinking and creativity in developing revolutionary aircraft solutions to significant problems in the future (energy efficiency, environmental compatibility, operations) and determine high-payoff technologies and research opportunities to address these national air transportation system challenges. Thus, Phase I competed for N+3 Concept Studies NRA awards were made to four subsonic aircraft teams and two supersonic aircraft teams to study advanced aircraft concepts that can address very stringent performance and environmental goals for air vehicles that are slated to enter service in the 2035 timeframe.

The results of Phase I N+3 18-month Advanced Concept Studies Completed revealed a range of fascinating technology concepts, tools, and capabilities with the potential to enable revolutionary air vehicle designs and propulsion systems for future air transportation systems. A short list of the key potential technologies that resulted from the N+3 Concept Studies' results includes:

Subsonic Fixed Wing Aircraft:

- Uniquely enabling concepts/technologies: strut/truss-braced wing, double-bubble aircraft, hybrid electric propulsion;
- Alternative energy: conventional/biofuel most prevalent plus hybrid electric;
- Engine bypass ratios approaching 20 (or propellers) with small, high-efficiency core engines;
- Higher aspect ratio and laminar flow wings for vehicles cruising at lower speeds and higher altitudes (approximately 40,000–45,000 feet); and
- Energy: conventional/biofuel most prevalent, plus hybrid electric.

Supersonic Aircraft:

- Highly integrated configurations with unique shaping to practically eliminate sonic boom and permit supersonic overland flight; and
- Variable flowpath propulsion systems to maximize cruise efficiency while lowering takeoff and landing noise.

Both Subsonic Fixed Wing and Supersonic Aircraft:

- Broadly applicable, critical technologies including flow control, light weight and higher temperature materials, aeroelastic structures

The results of the Phase I N+3 Concept Studies provide critical data that will guide NASA in future technology investments for technology developments in both green aviation and air transportation systems, and also serve as a basis for Phase II proposals under evaluation. This would greatly enable the assessment and identification of critical needs and requirements (technology portfolio) for technology roadmap developments for potential future commercial aircraft scenarios and advanced vehicle concepts to meet the anticipated national challenges in the N+3 timeframe to achieve performance and environmental goals. The Phase II awards are expected to be made in November 2010.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Complete new suite of integrated multidisciplinary analysis tools to predict noise, NOx, takeoff/landing performance, cruise performance, and Take-Off Gross Weight (TOGW) for conventional ("tube and wing") aircraft and unconventional aircraft (e.g., hybrid wing-body).	None	8AT07 Green	9AT7 Green	10AT07 Green
Demonstrate control concepts through flight simulation that would contribute towards development of a flight control optimization tool for variable speed engine and transmission with no negative handling quality effects.	7AT4 Green	8AT09 Green	9AT8 Green	10AT08 Green
Develop computational models to predict integrated inlet and fan performance and operability and compare models to experimental data.	None	8AT11 Yellow	9AT9 Green	10AT09 Green
Complete CFD predictions of ramjet-to-scramjet mode-transition and compare to wind tunnel and/or X-51 flight test data.	None	None	9AT10 Yellow	10AT10 Yellow

Why NASA did not achieve APG 10AT10: NASA delayed this work into FY 2011 due to Air Force X-51 flight delays. NASA received the data from the first flight on May 26, 2010, in August 2010. The next flight (second of four) is scheduled for the December 2010 through January 2011 time period. The data from the remaining X-51 flights is required to meet APG. The APG completion date estimate has been revised to September 2011.

Plans for achieving 10AT10: Information from remaining flights of Air Force X-51 is required to achieve this APG.

This future aircraft design concept for supersonic flight over land dramatically lowers the level of sonic booms through the use of an "inverted-V" engine-under wing configuration. Other revolutionary technologies help achieve range, payload and environmental goals. This concept is one of two designs presented in April 2010 to the NASA Aeronautics Research Mission Directorate for its NASA Research Announcement-funded studies into advanced supersonic cruise aircraft that could enter service in the 2030-2035 timeframe.

Credit: NASA/Lockheed Martin Corporation

Outcome 3E.4: Ensure the continuous availability of a portfolio of NASA-owned wind tunnels/ground test facilities, which are strategically important to meeting national aerospace program goals and requirements.

FY07	FY08	FY09	FY 2010
None	Green	Green	Green

Credit: NASA

An engineer works with a model of the X-48B in one of NASA's wind tunnels.

Recovery Act funds working to keeping the Nation's aerospace assets ready

In FY 2010, NASA's Aeronautics Research Mission Directorate, through the Aeronautics Test Program (ATP), substantially reduced the Agency's deferred maintenance backlog for ground test facilities through an ambitious facility maintenance investment program, funded in part by the American Recovery and Reinvestment Act of 2009 (ARRA). ATP projects are selected on the basis of safety and reliability needs, technical performance and projected test capability requirements; much of which were identified by the 2008 ATP Facility Assessment effort. Overall, ATP investments in the first five years reduced the NASA deferred maintenance backlog for these national assets by more than 20 percent, based on deferred maintenance estimates for NASA wind tunnels in the FY 2006 NASA Deferred Maintenance Assessment Report.

ATP also implemented major capability upgrades with approximately $20 million in funding provided by the ARRA. Together with the above mentioned ARRA investments in major maintenance projects, this initiative represents the largest allocation for national wind tunnel investments in several decades. These investments will provide the testing community with significantly improved acoustic research capability and new engine icing research capability. The investments also provide upgraded data, control, and support process equipment to improve facility reliability and availability to address customer needs.

NASA provides aeronautical test facility access to many national partners. In FY 2010, ATP continued to collaborate with several national organizations to foster effective partnerships and working relationships with national partners including the Department of Defense (DoD) Test Resource Management Center, and the American Institute of Aeronautics and Astronautics U.S. Industry Test Facilities Working Group. ATP also sponsored or co-sponsored several working group meetings to promulgate the National Aeronautics Research and Development Policy.

On July 15, 2010, NASA management participated in the seventh National Partnership for Aeronautical Testing (NPAT) Council meetings convened in Arlington, VA. This meeting continued the exchange of ideas which will focus on strengthening the partnership and establishing a foundation that will lead to a national aeronautics test infrastructure strategy. Other participants included the DoD's director for the Defense Test Resource Management Center and representatives from the separate DoD services.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Achieve test customer evaluation ratings averaging greater than 90% for overall quality and timeliness of ATP facility operations, based on feedback received in post-test customer surveys.	None	None	None	10AT11 Green

Outcome 3E.5: For vehicle and propulsion technologies that simultaneously reduce fuel burn, noise, and emissions, by 2016 develop a well-informed trade space, document performance potential, and identify technical risks to a level that enables incorporation of the technologies into the design of new aircraft.

FY07	FY08	FY09	FY 2010
None	None	None	Yellow

Credit: NASA

A chase plane follows the remotely controlled X-48B as it makes a test flight.

NASA partners to advance hybrid wing body aircraft technology

An example of progress toward Outcome 3E.5 was shown during FY 2010, when a multi-government and industry collaboration between NASA, the Air Force Research Laboratory, Boeing, and Cranfield Aerospace, completed the first phase of the X48-B Low Speed Flight Test Program following its 80th test flight on March 19, 2010. All flights were flown at NASA's Dryden Flight Research Center at Edwards, CA.

Researchers conducted the X-48B Phase 1 flight test program in three distinct stages.

In the first stage, researchers flew the aircraft through a variety of maneuvers intended to define the overall flight capabilities away from stall regimes and to discern the general stability and flight handling characteristics of the aircraft.

In the second stage, NASA and its partners performed more aggressive maneuvers to assess the aircraft capabilities under more demanding flight conditions such as stalls, steady heading sideslips and engine-out maneuvers. In this stage, the plane was taken to its limit of controlled flight and successfully recovered.

In the third and final stage, "departure limiter assaults" were performed to challenge the ability of the aircraft's flight control system to prevent entry into uncontrolled flight regimes and to validate the software algorithms employed in the computerized flight control system to prevent such occurrence.

The flight test program of the X48-B, demonstrated the tailless hybrid wing body aircraft design could be safely flown and landed in a variety of flight conditions. Through the X-48B low speed flight tests and data analysis, NASA sought to:

- Explore the stability and control characteristics of a hybrid wing body class vehicle to better understand the unique flight control issues including basic stability, control authority, control interactions, dynamic characteristics, departure susceptibility, and ground effects.
- Develop and evaluate flight control algorithms with special consideration given to control surface allocation and blending, takeoff and landing characteristics, flying qualities, stall recovery, and departure resistance.
- Evaluate prediction and test methods for hybrid wing body class vehicles by correlating flight measurements with ground-based measurements and predictions.

The aerodynamic database is a principle factor in the fidelity of the simulation models. Therefore, the flight test aerodynamic Parameter Identification (PID) analysis was an essential element of the flight test data analysis effort to validate and update the simulation aerodynamic model. A comprehensive, accurate PID analysis enabled the X-48B Program to meet its flight test data analysis objectives and will enable further development of the hybrid wing body concept.

Researchers used the data obtained from the flight tests to develop accurate aerodynamic and control models and incorporated the models into the control system that ultimately will provide a firm basis for developing a system for a larger-scale hybrid wing body vehicle.

Why NASA is not on track to achieve Outcome 3E.5 as stated: In addition conducting research through test flights of a hybrid wing body aircraft configuration, NASA sought out additional advanced vehicle concepts from its stakeholders through a solicitation. NASA significantly re-scoped the effort for the NASA Research Announcement (NRA) mid-year, changing the requirements from an advanced vehicle concept study NRA to an advanced vehicle concept study that will develop two concepts to the Preliminary Design Review (PDR) stage.

Plans for achieving Outcome 3E.5: NASA is currently negotiating these contracts and expects to announce awards in the first quarter of FY 2011.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
In FY 2010, award a contract to conduct N+2 vehicle systems studies.	None	None	None	10AT12 Yellow

Why NASA did not achieve APG 10AT12: NASA significantly re-scoped the effort for the NASA Research Announcement (NRA) mid-year, changing the requirements from an advanced vehicle concept study NRA to an advanced vehicle concept study that will mature two concepts to Preliminary Design Review (PDR) stage.

Plans for achieving 10AT12: NASA is currently negotiating these contracts and expects to announce awards in the first quarter of FY 2011.

Sub-Goal 3F

Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.

Summary of Ratings for Sub-Goal 3F	
4 Outcomes	12 APGs
Green = 4	Green = 11
Yellow = 0	Yellow = 1
Red = 0	Red = 0
White = 0	White = 0

FY 2010 Cost of Performance (Dollars in Millions)
$252.0

When human explorers journey deeper into space, they will be subjected to the microgravity, radiation, and isolation of space for long periods of time. Keeping crews physically and mentally healthy during long-duration missions requires new technologies and capabilities. Through a combination of ground- and space-based research, NASA is studying how the space environment, close quarters, heavy workloads, and long periods of time away from home contribute to the physical and psychological stresses of space exploration. In addition, NASA is developing innovative methods and technologies that can prevent or mitigate the effects of these stresses and that meet the basic needs of astronauts, oxygen, water, food, and shelter, with systems that can operate dependably for long durations. This work ranges from studies on the risks of space travel to designing guidelines for ensuring astronaut health to creating and testing new life support hardware.

Benefits

The medical knowledge and diagnostic, preventative, rehabilitative, and treatment technologies NASA uses to keep humans healthy and productive in space can also improve the medical treatment and health of humans on Earth. For example, NASA's research into human adaptation to microgravity has helped scientists better understand the changes that come with aging, such as bone loss, muscle atrophy, and loss of balance.

Other branches of government have benefited from NASA technology sharing and expertise. NASA mobile communications platform designs for future lunar missions led to fleet improvements for tactical robots now being deployed by the U.S. Army. The Multi-function Agile Remote Control Robot (MARCbot) helps soldiers search out and identify improvised explosive devices. Over the years, companies have taken NASA life-support and medical technologies and have developed them into commercial products that serve the public. Light-emitting diodes, originally designed to grow plants in experiments aboard the Space Shuttle, are now used to treat brain tumors. Devices built to measure the astronauts' equilibrium when they return from space are widely used by major medical centers to diagnose and treat patients with head injuries, stroke, chronic dizziness, and central

Photo previous page: STS-131 and Expedition 23 crew members gather for a group portrait in the Kibo laboratory of the International Space Station while Space Shuttle *Discovery*. (Credit: NASA)

nervous system disorders. A company turned a small, portable device originally designed to warn Space Shuttle and ISS crewmembers of depressurization into a hand-held device that warns pilots, mountain climbers, skydivers, and scuba divers of hazardous conditions before depressurization and hypoxia become a health threat. Another company licensed powerful biosensor technology from NASA to use in its water analyzer, which can alert organizations to potential biological hazards in water used for agriculture, food and beverages, showers, and at beaches and lakes, within hours instead of the days required by conventional laboratory methods.

For more information on NASA technology transfer successes, please visit the Spinoff home page at *http://www.sti.nasa.gov/tto/*.

Risks to Achieving Sub-Goal 3F

A major challenge in completing all the planned experiments for long-duration space flight is the availability of flight opportunities to conduct research on crew and associated systems.

NASA in the Spotlight

NASA Assists Trapped Chilean Miners

After learning about the 33 miners trapped in the San Jose copper and gold mine near Copiapo, Chile, NASA experts were eager to offer their assistance. On August 31, a NASA team of experts arrived in Santiago as part of NASA's commitment to provide U.S assistance. As experts on working and living in small, dark, and isolated places, NASA offered advice on medical, nutritional, and behavioral health issues. The NASA team also provided suggestions regarding the rescue cages that were specially-designed to pull the trapped miners out of the shaft that was dug over 2,000 feet into the ground. The NASA team included two medical doctors, a psychologist, and an engineer experienced in training and planning for emergencies in human spaceflight and its protection of humans in the hostile environment of space. The NASA team urged the miners to regulate their sleep patterns and to start an exercise regime as soon as their nutrition improved.

All the miners emerged safely from the 2,300-foot escape shaft on October 13.

For more on this story go to h*ttp://www.nasa.gov/news/chile_assistance.html*.

Photo above: NASA Engineering and Safety Center Principal Engineer Clint Cragg consults with Rene Aguilar, deputy chief of rescue operations for the Chilean mine disaster. (Credit: C. Penafiel, U.S. Embassy in Chile)

Outcome 3F.1: By 2016, develop and test candidate countermeasures to ensure the health of humans traveling in space.

FY07	FY08	FY09	FY 2010
Green	Green	Yellow	Green

Improving ISS medical support systems

In FY 2010, NASA worked to enable long-duration human space missions by continuing efforts to understand and lessen the harmful effects of the space environment on humans and to develop new technologies that reduce mission resource requirements. Under the IntraVenous fluid GENeration (IVGEN) project, NASA developed a device to generate United States Pharmacopeia (USP) grade IV fluid in the microgravity environment on the ISS using materials already available on the ISS. Due to the large mass and volume and a finite shelf life of water, this new filtration system will save significant resources by generating IV fluids when needed. The hardware was launched to ISS in March 2010, and has been successfully integrated into the Multi-Purpose Logistics Module, where it has been operated to produce medical grade water. This device gives flight surgeons more options in treating ill crew members.

Reducing cancer risks for astronauts

Exposure to the radiation generated by solar particle events and galactic cosmic rays poses cancer risks to astronauts. To combat this problem, NASA developed a cancer risk projection code and evaluated uncertainties in factors that enter into the model. The NASA Cancer Risk Model will help predict an astronaut's chance of developing cancer. NASA also developed the Space Cancer Risk Model Graphical User Interface which integrates various components in the cancer risk projections in order to apply them to human space situations. NASA plans to use these tools for ISS missions and for future exploration missions to the moon, asteroids, or Mars.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Deliver a Human Interface Design Handbook for use in designing exploration vehicles.	None	None	None	10AC04 Green
Deliver and publish an initial version of the acute radiation risk projection model for lunar missions.	None	None	None	10AC05 Green
Deliver a device for launch to ISS to test the technology of producing medical grade water on a spacecraft.	None	None	9AC7 Yellow	10AC06 Green
Complete the assessment study of a capability to test bone and muscle countermeasures in simulated lunar gravity.	None	None	None	10AC07 Green
Complete the 2010 quantitative assessment of the uncertainties in cancer risk projections for space radiation exposures in support of lunar exploration missions.	None	None	None	10AC08 Green

Outcome 3F.2: By 2012, identify and test technologies to reduce total mission resource requirements for life support systems.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA

Astronaut Tracy Caldwell (right), flight engineer for Expeditions 23 and 24, participates in an Environmental Control and Life Support System (ECLSS) training session with instructor Cindy Koester. The ECLSS, which is onboard the ISS, includes systems for reclaiming water and generating oxygen. NASA is using the ISS as a test bed for technologies that will enable future long-duration human space missions.

Developing technologies for future lunar missions

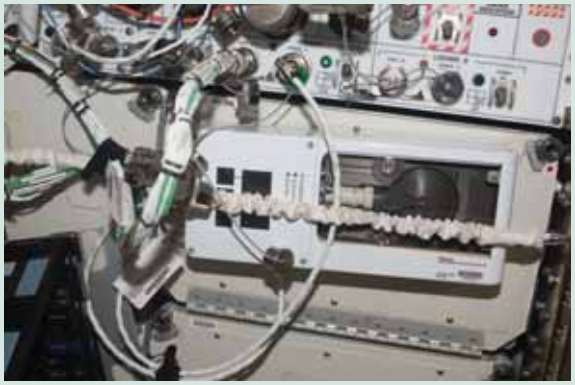
Long-duration human space missions require life support systems that are efficient, reliable, compact and which use minimal amounts of consumables. In order to support increases in mission duration, NASA carries out research to improve techniques for atmosphere management and for recycling the air to reduce the consumables associated with providing a breathable atmosphere, both of which are essential to maintaining a safe environment for human beings to live.

In support of a long-term strategy to develop air "recycling" technologies for future, long-term Moon missions, NASA conducted a trade study to evaluate candidate technologies for carbon dioxide reduction. This research included an analysis of currently available carbon dioxide reduction subsystem technologies and the consumables necessary for each system for one-, five- and 10-year missions. Based on these analyses, researchers provided conclusions and recommendations regarding which technologies should be developed into flight hardware.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
As part of technology development for closed-loop air revitalization for lunar surface habitats, conduct a trade study to evaluate candidate technologies for carbon dioxide reduction in support of down selection for development of a breadboard unit.	None	None	None	10AC09 Green

Outcome 3F.3: By 2012, develop reliable spacecraft technologies for advanced environmental monitoring and control and fire safety.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green



Credit: NASA

The ENose is shown installed in the U.S. Destiny Laboratory onboard the ISS.

A breath of fresh air in space

NASA monitors the interior of spacecraft to ensure that the safety of astronaut living quarters and the optimal functionality of the life support and habitation systems. Internal atmosphere monitoring works to detect any unusual events that may be caused by chemical spills or malfunctioning systems but can also track the functioning and efficiency of atmosphere management systems.

In April 2010, NASA launched the Vehicle Cabin Atmosphere Monitor (VCAM), an instrument that identifies minute quantities gases inside the ISS that could harm the crew's health. The VCAM operates autonomously and maintenance free, approximately once per day, with a self-contained gas supply sufficient for a one-year lifetime. If successful, instruments like VCAM could accompany crewmembers during long-duration exploration missions.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Demonstrate six months of experimental operation of the Electronic Nose (ENose) on orbit.	None	None	None	10AC11 Green
Demonstrate one year of experimental operation of the Vehicle Cabin Atmosphere Monitoring (VCAM) system on orbit.	None	None	None	10AC12 Yellow

Why NASA did not achieve APG 10AC12: NASA delivered and installed the VCAM in FY 2010. To date, the instrument has operated successfully; however, due to delays in the Space Shuttle launch schedule this instrument was not in place in time to demonstrate a full year of operation by the close of the fiscal year, per the annual performance goal.

Plans for achieving 10AC12: The VCAM is fully functional and on track for reaching one year of experimental operation in March 2011.

Outcome 3F.4: By 2012, identify and develop tools, methods, and technologies for assessing, improving and maintaining the overall health of the astronaut corps, for mission lengths up to 180 days in microgravity or 1/6 G.

FY07	FY08	FY09	FY 2010
None	None	Green	Green

NASA launches new systems to support astronaut health

In FY 2010, NASA developed an initial set of clinical practice guidelines for astronaut care in the following areas: onychomycosis (toe fungus), hypertension, hyperlipidemia (cholesterol), renal stones, and sleeping disorders. NASA also adopted the U.S. Preventive Services Task Force recommendations for preventive health screening and modified them to include additional occupational screenings for specific risks associated with space flight such as radiation exposure, microgravity and other environmental stressors.

NASA also replaced the Longitudinal Study of Astronaut Health with a new program, the Lifetime Surveillance of Astronaut Health (LSAH). The new LSAH began in the summer of 2010 and will screen and monitor astronauts for occupationally-related disease. This will allow for a systematic evaluation of astronauts to detect potential health problems at an early state and to facilitate action to prevent the development or progression of occupationally related diseases.

In FY 2010, NASA also launched a data management infrastructure to hold astronaut medical data. This multi-database system captures clinical data collected pre- and post-flight for all astronauts, some in flight data, and flight surgeon notes about missions as well as the reports generated by laboratories for various medical requirements. In populating that data management system, priority was given to current missions, and work is ongoing to enter the past mission data.

One of the most significant efforts in the use of tools, methods, and technologies for assessing, improving and maintaining the overall health of astronauts was applied toward the use of ultrasound on ISS. Ultrasound is the only imaging technology available in flight. In order to understand what is seen in flight, similar data must be available from pre-flight uses on the ground. This concept of operations has been implemented through the installation of ultrasound in the Johnson Space Center clinics and ongoing work to explore the usefulness of ultrasound for monitoring and diagnosing conditions. Furthermore, techniques for remote guidance of ultrasound sessions for use with non-clinician operators have been developed and these techniques have been shown to produce clinically useful data from sessions with non-clinician operators.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Capture 43% of current and former astronaut medical requirements data in a comprehensive medical data management infrastructure.	None	None	9SFS2 Green	10SFS01 Green
Create a set of clinical practice guidelines for monitoring known risks associated with space flight.	None	None	None	10SFS02 Green
Capture 100% of medical and environmental data required by Medical Operations in a form capable of queries.	None	None	9SFS3 Yellow	10SFS03 Green
Create an integrated concept of operations to use ultrasound for ground-based clinical care as a test bed for in flight uses.	None	None	None	10SFS04 Green

Strategic Goal 4

Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.

Summary of Ratings for Strategic Goal 4	
1 Outcome	5 APGs
Green = 0	Green = 4
Yellow = 0	Yellow = 0
Red = 0	Red = 0
White = 1	White = 1

FY 2010 Cost of Performance (Dollars in Millions)
$4,377.8

Strategic Goal 4 was originally set as a key component in supporting NASA's Mission. The Nation's current space transportation system, the Space Shuttle, is not designed for human exploration beyond low Earth orbit.

To achieve the long-term objective of returning explorers to the Moon and eventually sending them to Mars, NASA initiated the Constellation Program. The program has been responsible for projects focused on designing, building, and testing the Orion Crew Exploration Vehicle, the expendable crew launch vehicle Ares I, the heavy-lift cargo launch vehicle Ares V, and spacesuits and tools required by the flight crews.

In addition, projects under this Strategic Goal have focused on creating or transitioning associated ground and mission operations infrastructure from the Space Shuttle Program to supporting low Earth orbit missions. Orion was originally designed to be America's new spacecraft for human space exploration, capable of carrying four crewmembers to the Moon and serving as the primary vehicle for future missions transporting crew and cargo to and from the International Space Station. The Ares I design consisted of a solid rocket booster and an upper stage capable of launching Orion into low Earth orbit. In FY 2010, activities under this Strategic Goal have been delayed or shifted to reflect new Presidential and Congressional direction in NASA's space exploration goals.

Benefits

If completed, Orion would have supported the expansion of human exploration missions and provided the means to take humans to the Moon to conduct scientific activities and make discoveries that cannot be achieved solely with robotic explorers. Although NASA's goals relating to this program have changed, NASA is optimistic that many capabilities developed by the Constellation Program will feed forward into new programs. For example, NASA is exploring options to use the Orion capsule for autonomous rendezvous and docking. Work carried out in the areas of advanced robotics, propulsion development and testing, friction stir welding, autonomous landing and hazard avoidance, and entry, descent, and landing technologies will enable further advancement in the new initiative areas directed by Congress and the President.

NASA's efforts to develop Orion and the Ares launchers have accelerated the development of technologies that are important for the economy and national security. The advanced systems and capabilities required for space travel include power generation and storage, communications and navigation, networking, robotics, and improved materials, all of which could be used on Earth to meet commercial and other national needs.

Photo above: NASA Dryden visual communications manager Steve Lighthill carefully smoothes out a NASA logo decal after affixing it to the Orion test module that will be flown in the Launch Abort System flight tests. (Credit: NASA/T. Landis)

Risks to Achieving Strategic Goal 4

In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.

(Right) On May 27, 2010, a weld technician looks on as the bulkhead and nosecone of the Orion spacecraft are joined using friction stir welding at NASA's Michoud Assembly Facility in New Orleans. The vehicle was inverted in the tool for this weld.

(Above) Another weld technician monitors as the Universal Weld System completes the final friction stir weld on the Orion spacecraft.

Nondestructive evaluations will validate the strength and integrity of the weld before the spacecraft is prepped for ground testing in flight-like environments, including static vibration, acoustics, and water landing tests.

(Credit, both: NASA)

Outcome 4.1: No later than 2015, transport three crewmembers to the International Space Station and return them safely to Earth,demonstrating an operational capability to support human exploration missions.

FY07	FY08	FY09	FY 2010
Yellow	Yellow	Yellow	White

Credit: NASA

The Crew Module lands successfully after the Pad Abort-1 test on May 6, 2010, at White Sands Missile Range in New Mexico. Three main parachutes lowered the Crew Module to the ground.

The Constellation Program performed significant and successful flight demonstrations in FY 2010, including the Ares 1-X Launch (see the Strategic Goal 4 highlight in *Performance Results* for more information), the Ares I First Stage Development Motor Test firing, and the Pad Abort-1 test for the Orion Crew Exploration Vehicle.

Why NASA rated Outcome 4.1 White: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and Outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Complete Pad Abort-1 test for the Orion Crew Exploration Vehicle.	None	None	9CS6 Yellow	10CS01 Green
Complete the integrated Preliminary Design Review (PDR) for the Constellation Program.	None	8CS14 White	9CS12 Yellow	10CS02 White
Complete Ares 1 First Stage Development Motor (DM-2) test firing.	None	None	None	10CS03 Green
Complete the Preliminary Design Review (PDR) for the Ground Operations (GO) Project.	None	8CS04 White	9CS3 Yellow	10CS05 Green
Complete the Preliminary Design Review (PDR) for the Mission Operations (MO) Project.	None	8CS11 Yellow	9CS4 Yellow	10CS06 Green

Why NASA rated 10CS02 White: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.

Strategic Goal 5

Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Summary of Ratings for Strategic Goal 5	
3 Outcomes	10 APGs
Green = 2	Green = 8
Yellow = 1	Yellow = 2
Red = 0	Red = 0
White = 0	White = 0

FY 2010 Cost of Performance (Dollars in Millions)
$189.7

Through Strategic Goal 5, NASA primarily seeks to support new launch services and technologies that will enable future robotic and human missions. Many of NASA's robotic missions are already launched on commercial vehicles, and as the Space Shuttle nears retirement, NASA is pursuing ISS crew and cargo delivery and return services provided by U.S. launch service companies.

Also in line with this Strategic Goal, the Agency partners with industry and academia to leverage outside investments and expertise while providing an economic incentive to invest in NASA programs. The Innovative Partnerships Program (IPP) consists of three elements: Technology Infusion, Innovation Incubation, and Partnership Development. Together, these program elements serve to increase the range of technology solutions for NASA, enable cost savings, and accelerate technology maturation. All of IPP's functions primarily serve NASA's mission interests, both near- and long-term, and with respect to a broad range of technologies and technology readiness. IPP targets a broad spectrum of U.S. industrial and non-profit entities and provides them the opportunity for grass-roots direct involvement in NASA's exploration and other missions.

NASA's Commercial Crew and Cargo Program applied $50 million American Recovery and Reinvestment Act (ARRA) funds to stimulate efforts within the private sector to develop and demonstrate human spaceflight capabilities in an effort is known as Commercial Crew Development (CCDev). These efforts are fostering entrepreneurial activities leading to job growth in engineering, analysis, design, and research and are supporting the creation of new markets.

Benefits

Since NASA's creation in 1958, the commercial sector has been an important Agency partner in space exploration. NASA purchases launch services for robotic missions from the commercial space sector. NASA also works with commercial partners to develop communication and navigation systems, build spacecraft, and design spacesuits. Along the way, the commercial space sector has grown into a multi-billion dollar industry that delivers numerous services, such as satellite television and global navigation, to the public and contributes to a strong U.S. economy.

Photo above: The United Launch Alliance Atlas V rocket carrying NASA's Solar Dynamics Observatory heads into the "wild blue yonder" from Launch Complex 41 an Cape Canaveral Air Force Station on February 11, 2010. The Atlas V is one of the commercial medium-heavy lift expendable launch vehicles available to NASA for launching robotic missions. NASA is working with commercial launch providers to expand the selection of available vehicles, particularly in the small and medium class. (Credit: S. Joseph and T. Gray)

Historically, several large corporations have dominated the commercial space industry, but now start-up ventures are pushing the industry into new areas. The Commercial Orbital Transportation Services (COTS) program supports aerospace companies to demonstrate orbital cargo transportation services, and are designed to encourage the emerging industry. By helping emerging companies, expand their services and increase their experience, NASA supports the growth of a competitive market and provides NASA with access to new capabilities.

Advancing technology through partnerships has always been important to NASA, not only to address NASA's needs, but also to apply NASA-derived technology to a range of applications that provide broad benefit to the public. IPP provides the technology solutions for NASA programs and projects through dual-use technology development and joint-partnerships. By broadening NASA's connection to emerging technologies, IPP provides an increased range of technological solutions for programs while reducing costs. IPP provides technology transfer out of NASA (called spinoffs) for commercial or socio-economic benefit to the Nation. In addition, IPP facilitates protection of the government's rights in NASA's inventions, as mandated by legislation. Technology Transfer, Small Business Innovative Research (SBIR), and Centennial Challenges tap into sources of innovation outside NASA and leverage NASA's resources with private or other external resources to develop new technologies for NASA mission use. IPP also transfers technologies having strong potential for commercial applications yielding public benefits.

Risks to Achieving Strategic Goal 5

Using new launch systems presents potential increased risk to the Agency because the companies' launch systems are unproven. NASA needs to balance the need to encourage emerging companies against the need to carry out Agency missions with limited risk. The successful implementation of commercial services involves detailed technical work needed to successfully integrate private sector vehicles and NASA systems. With funded and unfunded partners onboard for the COTS project, NASA and its partners are working closely to ensure that for launch services to the ISS, the communications, docking or berthing, operational, and navigational interfaces are well planned and the technical requirements well understood. In addition, the commercial partner services must prove, through the ISS safety panel process, that their system is sufficiently safe to be allowed to approach the station.

NASA faces issues with all classes of launch services. Small class launch services market is experiencing an increase in the available launchers but a limited supply of payloads. This limited market may make it difficult to sustain multiple suppliers and desired competition. Although there are no immediate replacements for medium-class launch services for NASA's robotic missions, the SpaceX Falcon 9 has experienced a successful launch and NASA continues to work with SpaceX and other emerging providers to help meet NASA's current and future launch services requirements.

Outcome 5.1: Develop and demonstrate a means for NASA to purchase launch services from emerging launch providers.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA

An Aerojet AJ26 rocket engine was delivered to NASA's Stennis Space Center on July 15, 2010. This is the first of a series of Taurus II engines to be tested at Stennis to include acceptance testing of flight engines. Stennis will provide propulsion system acceptance testing for the Taurus II space launch vehicle, which is being developed by Orbital Sciences Corporation. The first Taurus II mission will be flown in support of NASA's Commercial Orbital Transportation Services cargo demonstration to the International Space Station.

NASA partners with emerging launch providers

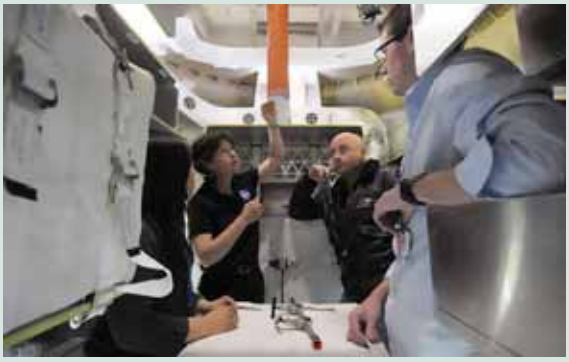
The Launch Services Program (LSP) completed a major procurement by awarding the NASA Launch Services (NLS) II Contracts (4) in September 2010. These contracts brought several new launch vehicles closer to reality, opening the door for additional competition in the small to small/medium class range of launch services.

To encourage and provide assistance to emerging launch providers, NASA's LSP participated in a series of technical interchange meetings with emerging providers Space Exploration Technologies (SpaceX) regarding the Falcon 1 and 9 launch vehicles and with Orbital Sciences Corporation, regarding the Taurus II launch vehicle. NASA's LSP also worked with SpaceX to assess Falcon 1 performance and provide feedback on trajectory modeling and performance and assessed the successful Falcon 9 maiden flight. As with other providers contributing to NLS contract, the Agency established an LSP resident office in the summer of 2010 at SpaceX's design and manufacturing facility in Hawthorne, California, to enhance communications between the organizations.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
The Launch Service Program will capture 100% of significant technical interchange information with emerging launch providers as provided under existing contract mechanisms. The Engineering Review Board Information System (ERBIS) will be used to capture specific technical recommendations and opportunities for risk reduction.	7SFS4 Green	8SFS01 Green	9SFS5 Green	10SFS05 Green

Outcome 5.2: By 2010, demonstrate one or more commercial space capabilities for ISS cargo and/or crew transport.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Yellow



Credit: SpaceX

NASA astronauts Cady Coleman and Scott Kelly discuss spacecraft cargo operations with SpaceX engineers as part of training with SpaceX's Dragon spacecraft. The Dragon is part of the company's launch vehicle/spacecraft system being developed under COTS.

NASA partners complete milestones

NASA's Commercial Orbital Transportation Services (COTS) project is an investment designed to spur development of a cost-effective, U.S. commercial capability to carry cargo to the International Space Station (ISS), with future options for transporting crew. The COTS project currently funds Space Act Agreements (SAAs) with two partners, Space Exploration Technologies Corporation (SpaceX) and Orbital Sciences Corporation (Orbital).

Throughout FY 2010, SpaceX and Orbital continued to make progress towards Outcome 5.2 by completing several agreed upon milestones. SpaceX completed two key milestones in FY 2010. In December 2009, SpaceX completed a cargo demonstration using a sample manifest that included physical stowage of cargo simulators in spacecraft and trunk, power and data to sample cargo, and verification procedures in preparation for the flight demonstrations. Additionally, SpaceX successfully completed the first Demonstration Readiness Review in preparation for its first COTS mission scheduled for early FY 2011.

Orbital successfully completed three key milestones in FY 2010. In November 2009, Orbital completed the ISS phase 2 safety review in accordance with the Space Station safety review process. Orbital completed their COTS system Critical Design Review (CDR), demonstrating completion of the design phase in March 2010, and in August 2010, completed assembly of the Service Module structure in preparation for structure testing.

Why NASA is not on track to achieve Outcome 5.2: Both partners, Space Exploration Technologies Corporation (SpaceX) and Orbital Sciences Corporation (Orbital), are making progress in demonstrating their respective transportation capabilities. The partners moved their initial demonstration flights to FY 2011 due to technical issues encountered during development efforts.

Plans for achieving Outcome 5.2: SpaceX is planning for its first ISS demonstration flight in late fall 2010 with remaining flights scheduled for later in FY 2011. Orbital currently is planning its ISS demonstration flight for fall 2011.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
In FY 2010, have at least one partner demonstrate flight proximity operations with ISS.	None	8CS08 Yellow	9CS9 Yellow	10CS07 Yellow
By the end of FY 2010, conduct one or more demonstration flights to, and berth with, the ISS.	None	None	None	10CS08 Yellow

Why NASA did not achieve APG 10CS07: Both partners, SpaceX and Orbital, made progress in demonstrating their respective transportation capabilities. The partners moved their initial demonstration flights to FY 2011 due to technical issues encountered during development efforts and are continuing toward demonstrating flight operations with ISS in FY 2011.

Plans for achieving 10CS07: The second SpaceX flight, in June 2011, will demonstrate flight proximity operations with ISS. Orbital currently anticipates scheduling its demonstration flight for FY 2012.

Why NASA did not achieve APG 10CS08: Both partners, SpaceX and Orbital, made progress in demonstrating their respective transportation capabilities. The partners moved their initial demonstration flights to FY 2011 due to technical issues encountered during development efforts and are continuing toward demonstration flights to, and berthing with, ISS in FY 2011.

Plans for achieving 10CS08: SpaceX is planning for its third demonstration flight to, and berth with, ISS in late FY 2011. Orbital currently anticipates scheduling its demonstration flight for FY 2012.

NASA in the Spotlight

Taking the "Search" out of Search and Rescue

Their emergencies happened hundreds, if not thousands, of miles from one another, but the captain whose vessel had become disabled near Kamalino, Hawaii, the pilot who crashed onto the Knik Glacier near Anchorage, Alaska, and the hiker who suffered a compound fracture while hiking near Merritt, Washington, all share a common experience: They were plucked to safety in the weeks leading up to the Labor Day 2010 weekend due to NASA technology.

In the 30 years since it began operations, the international Search and Rescue Satellite-Aided Tracking (SARSAT) program has saved more than 28,000 lives worldwide. Although this technology has helped save thousands of lives saved, perhaps the one rescue that most clearly demonstrates the value of the space-based search and rescue system is the one involving 16-year-old Abby Sunderland, who was saved in June after floating helplessly in the Indian Ocean about 2,000 miles from Madagascar after a violent storm had damaged her 40-foot vessel, *Wild Eyes*.

In the ultimate display of NASA spin-off technology, Abby's life was changed with a small yellow device, the MicroPLB Type GXL developed under a NASA Small Business Innovation Research (SBIR) program award to Microwave Monolithics Inc. NASA had provided Microwave Monolithics with the specifications to design the beacon, which relayed her distress signal to a SARSAT satellite.

Engineers at NASA's Goddard Space Flight Center, along with NOAA, the Coast Guard, and the Air Force, are developing a new search and rescue system that will detect and locate distress signals from beacons in less than five minutes. The current system, which places repeaters on weather satellites, can actually take up to an hour or more to locate the distress signal depending on the position of the satellite. The Distress Alerting Satellite System will be more efficient because the repeater technology will be placed on the Air Force's 24 Global Positioning System (GPS), instead of NOAA weather satellites.

For more on this technology transfer story go to *http://www.nasa.gov/centers/goddard/news/features/2010/search-and-rescue.html*.

Photo above: Abby Sunderland waves from her vessel, *Wild Eyes*, as she attempted to be the youngest person to sail the world solo. (Credit: GizaraArts.com)

Outcome 5.3: Promote and develop innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and projects.

FY07	FY08	FY09	FY 2010
Green	Green	None	Green

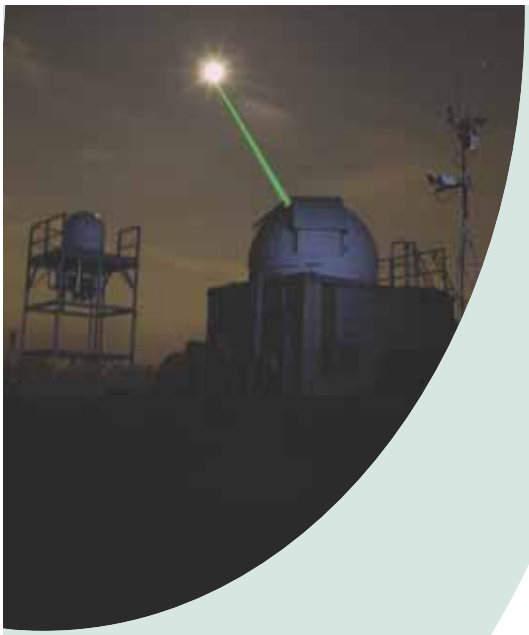
The purpose of the Outcome is to add value to Mission Directorate programs and projects through joint technology development/maturation, at less cost, through partnerships and resulting infusion targeted on Mission Directorate technology gaps to meet mission needs. In addition, outcome objectives include facilitating the transfer of inventions and technologies to which NASA has title for commercial application and for other public benefits; and infusing commercial applications, or adaptations thereof, thereby incorporating NASA's own technologies back into NASA's missions. Strategies include engaging Mission Directorates at Headquarters and Centers, reaching out to external sectors, and increasing participation from new sources of innovation to address NASA's technology challenges. IPP's role may reasonably be characterized as a facilitator and catalyst in achieving these objectives.

During FY 2010 the inventions of NASA civil servants that IPP had previously reported via its Web-based New Technology Reporting (NTR) tool were recognized by entities like the *Wall Street Journal*, *R&D Magazine*, the Federal Laboratory Consortium, and the Northeast Ohio Technology Coalition. IPP reported on 47 new and significant successful transfers of NASA technologies in the 2010 edition of *Spinoff* magazine.

During the year at least 68 technologies were infused into various NASA programs from IPP's technology investment portfolio. Infused technologies from non-NASA entities and commercial firms fly on NASA missions during the year, are adopted for use in future missions, are chosen for further development after emerging from the IPP portfolio, or otherwise participate meaningfully in NASA's projects and activities. The NASA investment portfolio spans the range of initiatives sponsored by IPP's SBIR/STTR, Seed Fund, Centennial Challenges, FAST, and partnership program elements; together the portfolio provides a constellation of opportunities for non-NASA entities and commercial firms to participate in NASA's ongoing mission. The most significant component of the portfolio, measured in dollar terms, is the assortment of contracts and awards sponsored by the SBIR/STTR program; the FY 2010 edition of *Spinoff* magazine documented approximately 50 new commercialization successes sponsored through SBIR/STTR.

Spinoff is available online at *http://www.sti.nasa.gov/tto/*.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Document 40 notable technology transfer successes in NASA's Spinoff publication.	None	None	None	10IPP01 Green
Produce 1100 New Technology Reports (NTRs) produced, representing the new technologies available for potential transfer.	None	None	None	10IPP02 Green
Ratio of total number of licenses generated from the Intellectual Property (IP) portfolio of patents from the last five years relative to the number of patents in that portfolio is equivalent to 40%.	None	None	None	10IPP03 Green
Initiate or expand 29 SBIR/STTR Phase III contracts.	None	None	None	10IPP04 Green
Achieve 175 technology readiness level (TRL) advancements from the Innovative Partnerships Program portfolio of technology development.	None	None	None	10IPP05 Green
Infuse 68 technologies into NASA programs/projects from total Innovative Partnerships Program portfolio.	None	None	9IPP4 Green	10IPP06 Green
Ratio of SBIR/STTR technologies successfully infused into NASA programs/projects relative to the prior five years of SBIR/STTR Phase II contracts issued is equivalent to 21%.	None	None	None	10IPP07 Green



Strategic Goal 6

Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

Summary of Ratings for Strategic Goal 6	
4 Outcomes	12 APGs
Green = 2	Green = 11
Yellow = 0	Yellow = 0
Red = 0	Red = 0
White = 2	White = 1

FY 2010 Cost of Performance (Dollars in Millions)
$560.9

NASA laid the foundation for the lunar return program by focusing Agency research on robotic reconnaissance explorers, surface nuclear power systems, and advanced communications systems. NASA has conducted extensive research and leveraged partnerships with industry and the international space community to acquire next-generation technologies for life support, communications and navigation, radiation shielding, power generation and storage, propulsion, and resource extraction and processing.

In FY 2010, activities under this Strategic goal have been delayed or shifted to reflect new Presidential and Congressional direction in NASA's space exploration goals.

Benefits

NASA and the Agency's partners transfer advanced space exploration systems and capabilities, power generation, communications, computing, robotics, and improved materials from space exploration research and execution, to the commercial sector to serve public, national, and global needs. In the past, technologies developed for space exploration have yielded ground-based applications, such as non-polluting solar energy systems, advanced batteries for laptop computers and cell phones, and fuel cells for electric vehicles.

The activities under Strategic Goal 6 lay the groundwork for NASA's future human space exploration goals. Even as goals shift, the capabilities and knowledge developed under this Strategic Goal will feed forward into new areas of focus and will continue to benefit other efforts across NASA. New power generation and nuclear technologies will help future space exploration missions while autonomous systems and integrated systems health management support safer and more efficient air travel.

Risks to Achieving Strategic Goal 6

Many of the new, advanced technologies required for NASA's robotic and human exploration missions are either in formulation or the early stages of development. As such, they are subject to challenges that affect any project in its early stages including: reductions in planned budget may prevent technologies from being matured in time to support preliminary design of flight systems; the evolving lunar program architecture may cause technology development priorities to change; and technologies may be more difficult to develop to the required level of maturity than originally anticipated.

Photo above: The Goddard Flight Research Center's Laser Ranging Facility directs a laser (green beam) toward the Lunar Reconnaissance Orbiter (LRO) spacecraft in orbit around the Moon (white disk). The Moon has been over-exposed to show the laser. Researchers are using ranging information from LRO, as well as lunar laser ranging data from other U.S. and international missions, to determine the orientation and orbit of the Moon and to establish highly precise latitude and longitude coordinate frames. This is valuable information when planning either robotic or human lunar exploration missions. (Credit: NASA/T. Zagwodzki)

Outcome 6.1: By 2012, complete the transition of applicable Shuttle components, infrastructure, and workforce to the Constellation Systems program.

FY07	FY08	FY09	FY 2010
Green	Yellow	Green	White

NASA alters transition strategy

Due to the Shuttle Manifest extension (announced November 2009), the FY 2011 President's Budget Release (February 2010), which requested the Constellation Program transition, and the creation of the Mission Support Directorate, NASA altered its strategy for ensuring the most efficient and comprehensive transition of applicable Shuttle components, infrastructure, and workforce. This aggressive campaign captures institutional requirements (including infrastructure and workforce) and will be managed at an Agency-level. This larger scope will provide better and more accessible data that can be used to make informed decisions across the Agency rather than at a program-specific level.

Why NASA rated Outcome 6.1 White: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. The proposed changes to the human spaceflight program in FY 2011 had an impact on civil service and contractor workforce planning. While NASA is not planning reductions to the civil service workforce, the nature of the work done by the civil service workforce would change under the President's FY 2011 budget plan. NASA has also made preliminary program assignments across the Centers for new or extended activities proposed in the FY 2011 budget, helping to clarify the work opportunities for contractors under the proposed portfolio and preparing NASA to execute the work content.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Complete the Exploration Requirements for Institutional Capabilities (ERIC) database update and develop a coordinated final SOMD/ESMD report that incorporates the ERIC update with the Space Shuttle Program's final assessment of real property.	None	8CS07 Green	9CS8 Green	10CS09 Green
Complete the Constellation Assessment of Personal Property (CAPP) for Space Shuttle Program property.	None	8CS07 Green	9CS8 Green	10CS10 Green
With the Space Shuttle Program, complete and deliver 2 Agency workforce transition strategy report updates to Congress.	None	8CS07 Green	9CS8 Green	10CS11 Green

Outcome 6.2: By 2016, develop and test technologies for in situ resource utilization, power generation, and autonomous systems that reduce consumables launched from Earth and moderate mission risk.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA/T. Landis

An S-64 heavy-lift helicopter operated by Erickson Air-Crane carries the ALHAT lidar equipment during a July 2010 flight test at NASA's Dryden Flight Research Center. The helicopter carrying the ALHAT lidar equipment flew over a varied obstacle course set up on Rogers Dry Lake to test the sensor's ability to distinguish the various materials, sizes, shapes, and colors while providing precision vehicle velocity and position. The sensor is being developed to help assure safe landings of future manned and robotic spacecraft on extraterrestrial bodies.

NASA tests hazard avoidance system

In FY 2010, NASA made significant progress towards demonstrating an autonomous hazard avoidance system for the Altair lunar lander.

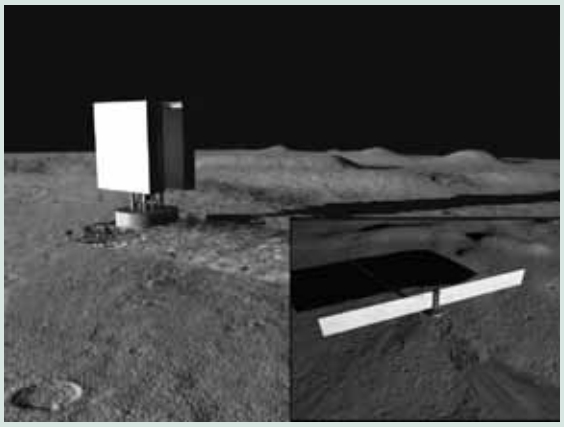
Future missions will need to land near specific resources that are located in potentially hazardous terrain. This capability will be possible when landers are equipped with the ability to automatically recognize the location of the desired landing site while detecting landing hazards during the final descent to the surface. Two critical technologies that must be developed to enable this capability are an active sensor for measuring the topography of the landing site and terrain analysis algorithms.

To prove that these technologies are ready for flight, they must be tested using both field tests and high fidelity simulations. The Autonomous Landing and Hazard Avoidance Technology (ALHAT) field test was conducted in July 2010 at NASA's Dryden Flight Research Center using an Erickson Air-Crane helicopter. This test was designed to integrate the ALHAT navigation system with a flash lidar on a gimbal with real-time sensor control and data collection software.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Demonstrate autonomous hazard avoidance system for Altair lunar lander in helicopter flight test.	None	None	None	10AC13 Green

Outcome 6.3: By 2013, sufficiently develop and test technologies for nuclear power systems to enable an informed selection of systems for flight development to provide power to a lunar outpost.

FY07	FY08	FY09	FY 2010
None	Green	Green	Green



Credit: NASA

Above is an artist's concept of fission surface power technology for lunar exploration.

Prototype pump shows its capabilities in test

In FY 2010, NASA made progress on a project to develop fission surface power technology options by 2013 to support an expected NASA decision to develop flight power systems.

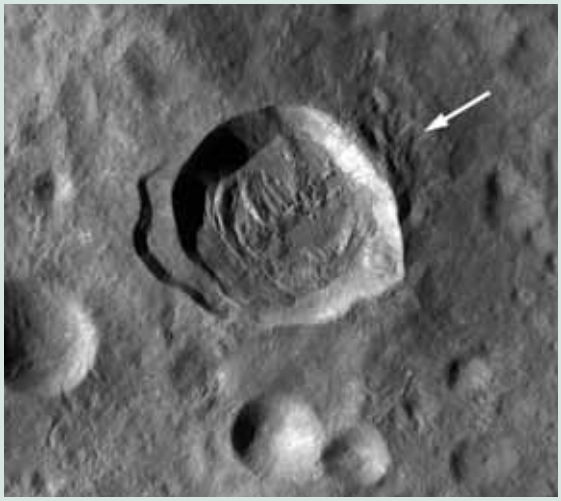
For flexible destinations, crew members would be highly dependent on the power system to achieve mission objectives and assure human safety. Nuclear power systems are best suited for long duration missions that require a robust power capability in difficult environments where solar power is limited.

Specifically, NASA successfully conducted performance testing of a full scale, prototypic electromagnetic Annular Linear Induction Pump (ALIP) with liquid sodium potassium fluid at operating conditions relevant to a future 40 kilowatt surface power system at NASA's Marshall Space Flight Center. ALIP offers highly reliable capability with no moving parts and the potential for very long life—15 to 20 years—without the need for maintenance or repair. In this test, the pump met the flow rate and pressures at operational temperatures of the design specifications. The test results identified design characteristics for ensuring the needed performance levels for space power reactor systems.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
For the Liquid-metal Pump Demonstration, complete final report of performance testing of a prototypic annular linear induction pump with sodium-potassium fluid at operating temperatures and flow rates that are relevant to a future 40 kilowatt fission surface power system.	7ESRT5 Green	8AC17 Green	9AC15 Green	10AC14 Green

Outcome 6.4: No later than 2020, demonstrate the capability to conduct an extended human expedition to the lunar surface and lay the foundation for extending human presence across the solar system.

FY07	FY08	FY09	FY 2010
Green	Green	Green	White



Credit: NASA/Arizona State University

This view of the Necho crater taken by LRO shows impact melt concentrated outside the northeastern rim (indicated by the arrow). Impact melts play a key role in understanding when things happened on the Moon. As rock is melted and then cools and reforms, its internal radiometric clock is reset. By collecting a sample of impact melt scientists can very accurately determine when that crater formed. Since crater rays run out long distances scientists can determine the relative ages of rays, material that underlies rays, and rays that cross other rays. By sampling a few key craters scientists could easily unravel the absolute chronology of some key events on the Moon over the past billion years

NASA experiments help identify hardware needed for future surface missions

To embark on a human mission to the Moon or any other planetary body, NASA must gain an understanding of the environment and develop technical capabilities that are more efficient than current technologies. In FY 2010, the Agency evaluated concepts for lightweight composites for large structures that may be useful in Ares V interstage and intertank structures. Researchers evaluated eight architectural concepts and identified both sandwich and stiffened skin concepts for further consideration.

In addition, NASA conducted tests on liquid oxygen and methane engines for possible use on planetary missions where utilization of in-situ resources is a possibility. Scientists at NASA's White Sands Test Facility carried out a total of 48 sea level tests and eight altitude tests on the Aerojet 5,500-pound, liquid oxygen and liquid methane, ascent main workhorse engine. Researchers collected better than expected results based on pretest predictions from the sea level test results.

NASA collects never before seen images from the Moon

The Lunar Reconnaissance Orbiter (LRO), an unmanned mission tasked with creating a comprehensive atlas of the Moon's features and resources to aid in the design of a lunar outpost, and the Lunar Crater Observing and Sensing Satellite (LCROSS), which will determine if water ice occurs in an area of permanent shadow near the lunar poles, completed their post launch milestones for FY 2010. The LRO mission provided scientists with invaluable data on the Moon's surface including: images that provide important clues to the moon's recent geologic and tectonic evolution, new details about the entire half of the moon that is obscured from Earth, and imagery of lunar rilles that will help researchers to better understand these mysterious "river-like" features. In accordance with mission success requirements, the project has already submitted more than 50 percent of the gathered data to the Planetary Data System, a database which will help ensure the long-term usability of NASA data and to stimulate advanced research. In a successful completion of its mission, LCROSS discovered water and other volatiles on the lunar surface. Peer-reviewed publications of the LCROSS mission findings will be published in October 2010, in the journal *Science*.

For more information on LRO/LCROSS, please visit *http://lunar.gsfc.nasa.gov/*.

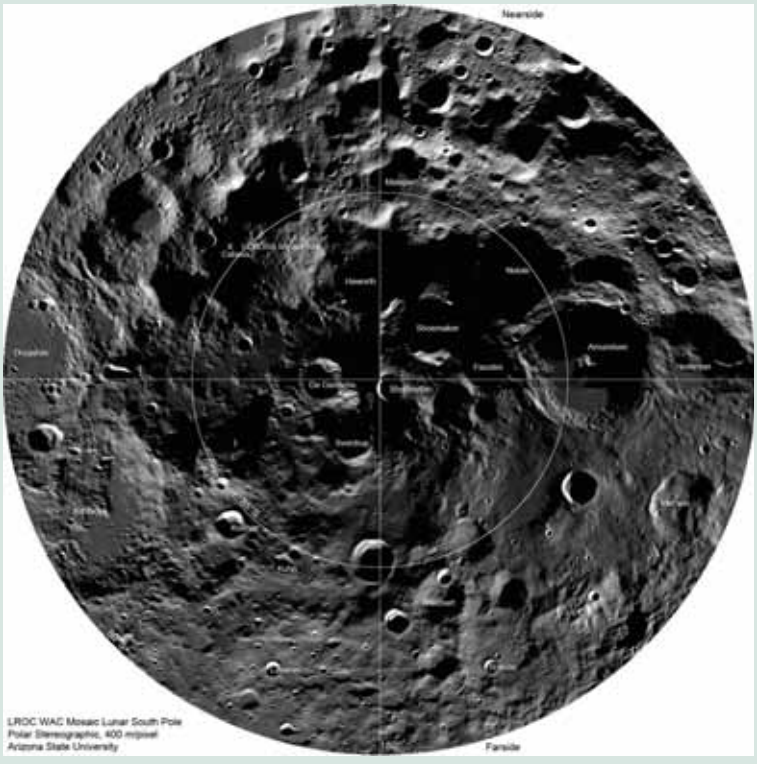
Why NASA rated Outcome 6.4 White: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Conduct the Lunar Capabilities Lunar Surface Concept Review (LSCR) to define the lunar mission architecture requirements.	None	8CS12 Green	9CS11 Red	10CS12 White
Develop concepts for manufacturing 10-meter diameter composite structures for the Ares V launch vehicle.	None	None	None	10AC15 Green
Test pre-prototype main engine for Altair lunar lander ascent stage using liquid oxygen and liquid methane propellants.	None	None	None	10AC16 Green
Complete LRO's primary mission and deposit 50% of the data to the Planetary Data System.	None	None	9AC16 Green	10AC17 Green
Complete the Lunar Crater Observation and Sensing Satellite (LCROSS) mission.	None	None	9AC17 Green	10AC18 Green
Complete at least 3 multilateral workshops with international space agencies to discuss the potential for international participation in exploration activities beyond low Earth orbit.	None	None	None	10DIO01 Green
Facilitate the exchange of at least 10 letters between the NASA Administrator and his international space agency counterparts, introducing the Administrator and outlining his vision for international cooperation.	None	None	None	10OER01 Green

Why NASA rated APG 10CS12 White: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.

This mosaic of the lunar South Pole region was created using images taken by LRO. The lunar South Pole is one of the most compelling places in the entire solar system. The towering massifs of the South Pole-Aitken Basin can be accessed, and these massifs contain impact melt that will allow scientists to unambiguously determine the age of this huge basin. Permanently shadowed craters may harbor reservoirs of ices and other volatile compounds that could serve as a tremendously valuable resource for future explorers. Additionally, these volatile deposits could contain a priceless record of water composition dating back to the beginning of the solar system, an incomparable dataset for astrobiology investigations. Finally, a few mountain peaks near the pole (just west and east of the rim Shackleton crater) are illuminated for extended periods of time, which could provide near-constant solar power for a permanent lunar outpost sometime in the far future.

Credit: NASA/Arizona State University



Cross-Agency Support Programs: Education

Summary of Ratings for Education	
3 Outcomes	11 APGs
Green = 3	Green = 9
Yellow = 0	Yellow = 2
Red = 0	Red = 0
White = 0	White = 0

FY 2010 Cost of Performance (Dollars in Millions)
Cross-Agency Support Program costs are distributed among the Strategic Goals.

NASA performs a leading role in inspiring the next generation of explorers by providing research opportunities, teacher training, lessons, exhibits, and hands-on activities that draw on NASA's unique missions. In 2008, the National Research Council affirmed, NASA has a unique and important role to play in motivating and inspiring students to consider science, technology, engineering, and mathematics (STEM) careers, and citizens to become more knowledgeable participants in the scientific arena. NASA's ambitious missions lead the Nation's exploration of Earth and its climate, the Moon, Mars, and beyond. They also engage teachers and learners of all ages in numerous formal and informal education venues.

NASA's Office of Education aligns the NASA education strategy with national STEM priorities, and actively collaborates with other Federal agencies, and state and local education leaders. The Office of Diversity and Equal Opportunity ensures that education and employment opportunities exist for all, regardless of race, ethnicity, gender, disability, or other status. NASA partners with academic institutions, professional education associations, industry, and other organizations in order to spark student interest and involvement. The Office of Education provides unique experiences to teachers and faculty, allowing them to participate in the excitement of NASA's discoveries. NASA supports students in STEM education, from elementary school through post-secondary degrees. Approaches include providing scholarships and internships, classroom and other instructional resources, on-line learning, education games, contests and competitions, and even controlling NASA's on-orbit research equipment from classrooms.

The Offices of Education and Diversity and Equal Opportunity are committed to recruiting a diverse talent pool, ensuring that NASA resources and opportunities are available to all, and actively engaging women, minorities, and persons with disabilities. The Office of Diversity and Equal Opportunity also takes a proactive role in making sure that NASA's grantees and partners operate in compliance with federal laws preventing discrimination.

Benefits

NASA's landmark achievements in air and space, made possible by scientific excellence and technical innovation, have deepened humankind's understanding of the universe while yielding down-to-Earth advances in air travel, health care, electronics, computing, and more. These achievements ultimately share a single source—education.

NASA's Office of Education uses NASA's unique missions and vast scientific and technical experience to inspire and motivate America's most important resource—its youth. By providing hands-on opportunities to students of

Photo above: Astronaut Yvonne Cagle poses for a photo with a young guest at Ames Research Center's kick-off event for Summer of Innovation. For more on NASA's Summer of Innovation visit: *http://www.nasa.gov/offices/education/programs/national/summer/home/index.html*. (Credit: NASA/D. Hart)

all ages, engaging them in simulations and authentic research, NASA hopes to stimulate creativity and encourage the growth of a new generation of scientists and engineers. The Agency's Education programs are designed to support NASA by ensuring that a highly skilled, diverse workforce will be available throughout our long-term missions. In the near-term, NASA will meet workforce needs by additional training for current employees and recruiting employees with skills and capabilities in emerging research and technology fields into the Agency.

As part of the longer-term plan, the Office of Education coordinates with the NASA's Offices of Human Capital Management and Diversity and Equal Opportunity to ensure that NASA's portfolio of education investments align with the long-term needs of the Agency. This includes supporting internships and fellowships at NASA Centers, to help inspire students at all levels to pursue STEM-related careers. NASA also provides professional development opportunities to STEM teachers, and develops interesting STEM content for the classroom, the Internet, and informal learning environments like museums and community-based organizations.

Risks to Achieving Education's Outcomes

The U.S. is facing increasing global competition in the areas of science, technology, innovation, but the performance of American students in math and science disciplines is falling behind other nations. Numerous studies and reports identify future risks to the workforce, economy, and national security if student interest and achievement in these areas are not addressed. NASA's education investments improve STEM teaching ability, increase the scientific literacy of students and the public, enable a better understanding of technology advances, help to build a stronger future STEM workforce, and improve the competitiveness of the Nation.

NASA's education is committed to reaching all learners, regardless of age, race, ethnicity, gender, socioeconomic status, disability, or geographic location. In FY 2009, thirty–nine percent of NASA's higher education students represented races and ethnicities that are underserved/underrepresented in STEM. Forty-two percent of participants were women.

Credit: NASA

Outcome ED.1: Contribute to the development of the Science, Technology, Engineering and Math (STEM) workforce in disciplines needed to achieve NASA's Strategic Goals, through a portfolio of investments.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA

NASA can help increase the research competitiveness of our Nation's colleges and universities by investing in infrastructures. Programs like the Experimental Program to Stimulate Competitive Research (EPSCoR), build research capability by sponsoring work that enables NASA's missions.

Note: FY 2009 Higher Education data is used in the FY 2010 PAR because grant reporting cycles for Education align with the calendar year rather than the fiscal year.

NASA works to attract diverse student body to STEM

NASA's higher education STEM programs provide opportunities that attract and prepare increasing numbers of students for careers that benefit NASA and the Nation. Student projects build, sustain, and effectively deploy the skilled, knowledgeable, diverse, and high-performing workforce needed to meet the current and emerging needs of NASA and the Nation's workforce. A second objective is to improve the competitiveness of underrepresented and disadvantaged universities and colleges by supporting research that contributes to the needs of NASA's Mission Directorates, also furthering the Nation's scientific and technology innovation agendas.

NASA makes a strong effort to ensure equal opportunity regardless of race, color, national origin, gender, disability, or age. The Office of Education and Office of Diversity and Equal Opportunity are both contributors to this goal and have realized successes in their programs in the past year. NASA raised the percentage inclusion of racially and ethnically underserved students to 40 percent of all higher education students in FY 2009. The Agency also successfully conducted five onsite Equal Opportunity compliance assessments of STEM programs receiving NASA funding in FY 2010. The Agency conducts such assessments to ensure that federal dollars fund activities that align with the highest standards of equality and fairness. Across the board, NASA has successfully provided targeted technical assistance to programs to help strengthen equality opportunity and inclusion efforts.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Support the development of 60 new or revised courses targeted at the STEM skills needed by NASA.	None	8ED01 Green	9ED1 Green	10ED01 Green
Serve 200 institutions in designated EPSCoR states.	None	8ED02 Green	9ED2 Green	10ED02 Green
Serve 8,500 under-represented and underserved students in NASA higher education programs.	7ED2 Green	8ED03 Green	9ED3 Red	10ED03 Yellow
Achieve 60% employment of student participants in FY 2009 NASA higher education programs by NASA, aerospace contractors, universities, and other educational institutions.	None	None	9ED5 Green	10ED04 Yellow
Achieve 45% pursuit of advanced education in NASA-related disciplines of undergraduate students in FY 2009 NASA higher education programs.	None	None	9ED6 Green	10ED05 Green
Provide equal opportunity (EO) onsite assessment and technical assistance to 3 STEM programs receiving NASA funding, and EO technical assistance to an additional 25 NASA-funded STEM programs.	None	None	None	10WF11 Green

Why NASA did not achieve APG 10ED03: In FY 2009, 6,743 higher education students self-reported as being part of an underserved and underrepresented race or ethnicity. This represents 40.6 percent of the total number of higher education students served by NASA in FY 2009, an increase from 28 percent of all higher education students similarly reporting in FY 2008. Of all higher education students served by the Agency, 43 percent self-reported being women, an increase from 41 percent in FY 2008. These figures are well above national averages for participation of minority students according to the National Science Foundation's report, *Women, Minorities, and Persons with Disabilities in Science and Engineering*, released in April 2010. The reduction in the number of minority higher education students served (6,743 students rather than the goal of 8,500) also reflects an increased emphasis on institutional awards for education and research, and a corresponding decrease in individual student awards. The overall reduction in direct support to all higher education students in turn affects the total number of higher education underserved and underrepresented students reached by NASA. In FY 2007, the total number of higher education students reached was 34,493; in FY 2008, the number dropped to 24,362, in FY 2009, it dropped further to 24,168. Higher education projects are adjusting to address this trend, but there is significant lag time before results are available (e.g., new course development time, time to execute activities, grant reporting lag time). Another factor adversely influencing the number of individual student awards is the increasing cost of education. To offer individual awards that remain competitive with those of other federal programs and industry, NASA grantees must increase award amounts that meet cost increases in tuition, travel, and other expenses. In a flat or reduced budget environment, an increase in award size means that fewer direct support awards can be made.

Plans for achieving APG 10ED03: NASA higher education projects are actively working to increase the participation of underrepresented and underserved students. Future efforts include plans to work more closely with community colleges and institutions that tend to serve large numbers of underserved students. The Space Grant Program, which works with affiliates in all 50 states, the District of Columbia, and Puerto Rico, has actively encouraged state consortia to better engage minority-serving institutions in their networks. The consortia are accountable for improving the participation of underserved students in their programs, determined as a percentage of their audience base. The strategy has been successful, as participation of racially and ethnically underserved and underrepresented students in the Space Grant Program has increased from 15 percent in FY 2007, to 21 percent in FY 2008, and to 29 percent in FY 2009.

Why NASA did not achieve APG 10ED04: In FY 2010, NASA's education workforce development target was 60 percent of students from NASA's higher education programs entering into NASA-related careers. Of the 1,343 students who self-reported employment data, 625 students (or 46.5 percent) reported working for NASA, aerospace contractors, universities, or other educational institutions. One project, Motivating Undergraduates in Science and Technology (MUST) was used as a prototype for more closely mapping an Office of Education project directly to the NASA Early Career Hiring Initiative. This collaborate approach succeeded in placing 22 of 29 graduates with NASA

and JPL. The overall drop in employment rate in these specific sectors, relative to previous years, may be a result of uncertainty in NASA's plans (e.g., retirement of Space Shuttle program, future of the Constellation program), and overall poor health of the U.S. economy in 2008–2009. However, 38.6 percent of graduates (in addition to those hired by NASA, aerospace industry and educational organizations), chose STEM-related careers. One might conclude that NASA in-depth education experiences are indicative of STEM workforce preparation.

Plans for achieving APG 10ED04: NASA organizations with a stake in developing the future workforce will continue to work collaboratively with each other and industry partners to identify future workforce trends and needs. New efforts in the One Stop Shopping Initiative include closer collaboration between NASA's hiring managers and mentors for higher education students.

NASA's Summer of Innovation (SoI) project and the Foundation for the Advancement of Women Now (FFAWN) are working together to encourage young women to pursue exciting experiences and career choices through studying science, technology, engineering and mathematics. A public service announcement featuring veteran NASA Space Shuttle astronaut Leland Melvin and FFAWN's founder, award-winning recording artist Mary J. Blige (shown in this clip taken from the public service announcement), debuted in mid-August 2010 on NASA TV and online.

The common goals SoI and FFAWN share resulted in this unique collaboration. Working with the NASA Science, Engineering, Mathematics and Aerospace Academy project at York College of the City University of New York (CUNY), the joint effort is providing on-the-job training for FFAWN high school participants.

The high school girls participating in the program will be prepared to deliver NASA SoI content to middle school students this summer at the New York City Housing Authority Van Dyke Community Center and the Harlem Children's Zone Promise Academy.

The FFAWN participants will also have the opportunity to support the NASA Academy fall academic session at CUNY as student aides for grades one through nine later this year.

To watch the public service announcement go to *http://www.nasa.gov/multimedia/videogallery/index.html?media_id=17421625*.

Outcome ED.2: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers and faculty.

FY07	FY08	FY09	FY 2010
None	Green	Green	Green

Credit: NASA

NASA seeks to attract and retain elementary and secondary students in STEM disciplines. Hands on opportunities develop fundamental skills and help increase student awareness of career options.

NASA uses variety of opportunities to attract students to STEM disciplines

NASA's ability to inspire student interest and achievement in STEM fields and disciplines of study is based in its unique mission, workforce, facilities, research, and innovations. NASA's Office of Education administers national STEM education programs that draw on content from across the Agency in pursuit of its education goals.

Partnerships and collaborations with national organizations, other space agencies, industry, academia, and other education professionals are an essential element in providing high-quality service to a widespread audience. Partnerships with schools, districts, science centers, and states support the national STEM education imperative and new initiatives. NASA's Elementary and Secondary Education and Informal Education programs inspire and foster achievement in STEM instruction and learning. A few of the approaches include providing research internships at NASA Centers; partnering with colleges of education to deliver workshops and courses for in-service and future educators; flying student developed experiments and hardware on NASA flight platforms (e.g., Space Shuttle, airplanes, sounding rockets, high altitude balloons); partnering with museums, science centers, and community organizations; and helping educators incorporate NASA STEM activities into schools' curriculum or after-school programming. Educational technologies expand the reach of NASA STEM content to audiences that have completed NASA programs or cannot easily access NASA Centers and facilities. Telepresence technologies now allow students and educators to interact with NASA's scientists and engineers, regardless of geographic distance.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Achieve 50% or greater level of interest in science, technology, engineering and math (STEM) careers among elementary and secondary students participating in NASA education programs.	7ED4 Green	None	9ED10 Green	10ED06 Green
Increase to 60% the percentage of elementary and secondary educators who either obtain NASA content-based education resources or participate in short-duration NASA education activities, and use NASA resources in their classroom instruction (a 1% annual increase above the FY 2007 baseline of 55%).	7ED6 Green	8ED05 Green	9ED7 Green	10ED07 Green
Increase to 470,000 the number of elementary and secondary student participants in NASA instruction and enrichment activities (a 5% annual increase above the FY 2007 baseline of 408,774).	7ED6 Green	8ED04 Green	9ED8 Green	10ED08 Green
Assure, in FY 2010, 75% of elementary and secondary educators who participate in NASA training programs use NASA resources in their classroom instruction, an annual increase of 5% in the FY 2007 baseline of 62%.	None	None	9ED9 Green	10ED09 Green

Outcome ED.3: Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.

FY07	FY08	FY09	FY 2010
Green	Green	Green	Green

Credit: NASA

NASA provides unique opportunities and content access to museums and science centers through its Museum Alliance. Each year, more than 400 institutions of informal education present information on NASA's discoveries and achievements. Activities include speaking engagements, teacher workshops, student camp-ins and family nights, real-time coverage of special events, and exhibits.

NASA takes STEM education to the public

In FY 2010, NASA promoted a continuous awareness of its Mission and STEM literacy by partnering with the NASA Museum Alliance, the Space Place Network (in every state), the Smithsonian, NASA Visitor Centers, and the Office of Education on a number of special projects. In FY 2010, 400 museums and science centers used NASA resources in programs and exhibits. NASA selected some of these institutions to develop and implement public engagement activities and enhance education programs related to space exploration, aeronautics, space science, Earth science, or microgravity through the Science Museums and Planetarium Grants initiative.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Assure that at least 350 museums and space centers across the country actively engage the public through NASA content.	None	8ED06 Green	9ED11 Green	10ED10 Green

Cross-Agency Support Programs: Agency Support

Contributions from Cross-Agency Support and Programmatic Appropriations Accounts

Summary of Ratings for Agency Support	
5 Outcomes	27 APGs
Green = 4	Green = 20
Yellow = 1	Yellow = 3
Red = 0	Red = 2
White = 0	White = 2

FY 2010 Cost of Performance (Dollars in Millions)
Cross-Agency Support Program costs are distributed among the Strategic Goals.

NASA's Cross-Agency Support Programs (CAS) provide critical mission support activities necessary to ensure the efficient and effective operation and administration of the Agency to include procurement, finance, human capital, information technology, real property and infrastructure, security, diversity, equal opportunity, and small business. Some NASA Offices and Programs that specifically report against Agency performance measures include:

- The Office of Safety and Mission Assurance, which ensures the safety and enhances the success of all NASA activities through the development, implementation, and oversight of Agency-wide safety, reliability, maintainability, and quality assurance policies and procedures;
- The Agency Information Technology Services Program, which provides business and management applications, common information technology (IT) infrastructure, IT security, and IT management services;
- The Strategic Capabilities Assets Program, which ensures that key capabilities and assets, such as wind tunnels and test facilities at Centers, are available for future missions and to help NASA prioritize and make strategic investment decisions to replace, modify, or disposition these capabilities/assets;
- The Human Capital Program which supports and enables NASA's mission by identifying, acquiring, aligning, and sustaining the workforce needed to meet current mission requirements, as well as the challenges that lie ahead; and
- The Office of Equal Opportunity and Diversity which promotes equal employment opportunity (EEO) in NASA's workforce and workplace environment, supports equal opportunity (EO) and diversity-inclusion initiatives and programs to enhance workplace productivity and efficiency, and advances in NASA-funded STEM programs.

The Space Communications and Navigation (SCaN) and the Rocket Propulsion Testing Programs (RPT), both run by Space Operations Mission Directorate, also contribute to and report against several Cross-Agency Support performance measures. The SCAN program coordinates multiple space communications networks as

Photo above: NASA's Kennedy Space Center and Brevard Workforce host a job fair to help Center employees with future planning and placement as the Space Shuttle Program comes to an end. Kennedy's Human Resources Office, as well as NASA's other Center Human Resources Offices, also host workshops, seminars, and other events to prepare employees as much as possible for future opportunities. (Credit: NASA/K. Shiflett)

well as network support functions to regulate, maintain, and grow NASA's space communications and navigation capabilities in support of all NASA's space missions while the RPT program manages NASA's rocket test propulsion assets, activities, and resources.

Benefits

These functions align and sustain institutional and program capabilities in support of NASA's mission portfolio requirements by leveraging resources, establishing and maintaining Agency-wide capabilities, and providing institutional checks and balances. CAS institutional capabilities ensure Agency operations are effective, efficient and that activities are conducted in accordance with all statutory, regulatory, and fiduciary requirements. CAS program capabilities ensure vital skills and assets are ready and available to meet technical milestones for programs and projects; ensure research is technically and scientifically sound; and ensure that Agency practices adhere to standards and processes that ensure safety and reliability through proper management of risk.

Risks to Achieving Cross-Agency Support's Outcomes

NASA continues to rebalance and prioritize mission support capabilities to meet mission requirements. Uncertainties within certain large NASA portfolios increase risk to the Agency across the CAS account. With large new initiatives within CAS for FY 2011, such as the IT consolidation across Agency through the IT Infrastructure Integration Program procurements, the ability for NASA to accommodate new or previously unidentified requirements will be difficult. Funds for high-priority initiatives, such as work force rebalancing, infrastructure deferred maintenance and reduction in Green House Gas Emissions (Federal Sustainability 13514, among other mandates), further constraints the Agency's flexibility to meet emergent and urgent requirements. NASA created the new Mission Support Directorate and Mission Support Council in FY 2010 to assist the Agency in meeting the difficult and dynamic challenges ahead.

NASA in the Spotlight

NASA's Buildings Are Going Green

NASA is doing its part to help "green" up the Federal government, including some award-winning building initiatives.

The NASA Ames Research Center's Sustainability Base, a candidate for the Leadership in Energy and Environmental Design (LEED) platinum-certified office building, is the winner of this year's U.S. General Services Administration (GSA) Real Property Award in the category of Green Innovation. The award category, Green Innovation, recognizes an innovation or idea with clear potential to transform the Federal community's overall energy and environmental performance.

For more on Ames' Sustainability Base go to *http://www.nasa.gov/externalflash/sustainability-base/index.html*.

In March, the Jet Propulsion Laboratory's (JPL's) environmentally friendly Flight Projects Center received a "Green Building Award" at the fourth annual Green California Leadership Awards. It is NASA's first Gold-certified building under the LEED rating system. The building's green assets include: a "living roof" of desert plants, low-flow faucets and toilets, a "smart" heating and cooling system, showers and bike racks for bike commuters, outdoor lights that reduce light pollution, and many more.

Photo above: A rooftop, drought-resistant garden not only helps insulate the roof of JPL's Flight Projects Center, it also creates an attractive view. (Credit: NASA)

Outcome AS.1: Develop, implement, and maintain modern, secure, and high-quality information technology systems and infrastructure to achieve Agency mission objectives with the lowest life-cycle cost and least risk.

FY07	FY08	FY09	FY 2010
None	None	None	Green

By advancing NASA's space and research program results through modern, secure, high-quality information technology systems and infrastructure, which are efficient, innovative, reliable, and responsive, at the lowest cost and least risk, the NASA IT organization strives to increase the productivity of scientists, engineers, and mission support personnel.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Complete migration to the NASA Consolidated Active Directory.	None	None	None	10IT01 Green
Complete Operational Readiness Review (ORR) for the NASA Communications Initiative.	None	None	None	10IT02 Green
Complete integration of Personal Identity Verification (PIV) cards with the desktop.	None	None	None	10IT03 Green
Complete planned capacity increase to the NASA Wide Area Network.	None	None	None	10IT04 Green
Complete planned upgrades to networks at Ames Research Center, Glenn Research Center, Goddard Space Flight Center, Kennedy Space Center, Marshall Space Flight Center, and Stennis Space Center.	None	None	None	10IT05 Green
Complete Operational Readiness Review (ORR) for the NASA Security Operations Center.	None	None	None	10IT06 Red
In FY 2010, increase the percentage of total travel bookings completed on-line to at least 60% (baseline is 1.8%).	None	None	None	10IT08 Green
In FY 2010, increase the total number of solicitations developed in PRISM to at least 80%.	None	None	None	10IT09 Green
Reduce runtimes of the most heavily accessed Business Warehouse reports by at least 40%.	None	None	None	10IT10 Green

Why NASA did not achieve APG 10IT06: The Security Operations Center (SOC) Implementation Project was scheduled to have the ORR this year, but has undergone schedule slips due to delays in facilities power modifications and further delays in receiving IT Security data from numerous sources across the Agency. These delays have negated the ability to complete the testing required in preparation of the Operational Readiness Review.

Plans for achieving 10IT06: The SOC Implementation Project will move forward with IT Security event data collection in fall 2010. As the data is obtained, the project will complete final system integration and validation testing. Upon completing validation testing and user training the project will precede to ORR currently scheduled for November FY 2011.

Outcome AS.2: Develop and align workforce strategies, programs, policies and processes to be consistent with the Agency's mission.

FY07	FY08	FY09	FY 2010
None	None	None	Green

NASA works to be a model of equal employment opportunity and diversity

NASA successfully completed all planned actions from the Model EEO Agency Plan for FY 2008–2010 (the Model Plan). The Model Plan is designed to identify, address, and ultimately eliminate deficiencies within the Agency's EEO programs and barriers to employment throughout the Agency. NASA's review in FY 2008 identified deficiencies in its current EEO programs, barriers to the advancement of African American and Asian American males into high level positions, and inadequate recruitment, hiring, and retention of individuals with disabilities.

In FY 2010, the Agency was able to resolve issues around Section 508 compliance (which requires comparable access for individuals with disabilities to electronic and information technology employed by the Agency) through a comprehensive new policy and greater coordination between key stakeholders (e.g., the Office of the Chief Information Officer, Office of Diversity and Equal Opportunity).

NASA also successfully developed and began implementation of an Agency Diversity and Inclusion Framework. The Framework is designed to assist mission success by fully integrating diversity and inclusion into the strategic decision-making of the Agency and by strengthening efforts to more strategically utilize and expand workforce talents, skills, and opportunities, thus maximizing individual potential and productivity Agency-wide. NASA deployed the first-ever Agency-wide Diversity and Inclusion Assessment Survey, which will help the Agency to develop a Diversity and Inclusion Strategic Implementation Plan to address issues and concerns identified through the Survey.

Nurturing NASA's future leaders

NASA Mission Directorates, Centers, and other mission support offices collaborated to create a five-year workforce plan that aligns workforce to support the Agency's missions, as proposed to Congress by the President. As part of the plan, the Agency created the Civil Service and Labor Expense account as a solution for funding issues caused by assigning labor costs to programs. The account is intended to assure that sufficient funding is provided for civil service workforce and to provide more flexibility for deploying workforce talents as needed to support NASA's programs. If that account structure is not enacted, NASA will alter the plan as necessary.

The Agency continues to support a 16-month leadership development program for emerging leaders at the GS–13 and –14 level called the Mid-Level Leader Program (MLLP), which began in 2009. Because a high number of current NASA leaders will be eligible for retirement in the next five years, the program assures that emerging leaders are ready to step into their new roles. The program specifically emphasizes tactical application of leadership skills on existing team and organizational challenges. The first cohort was selected in November 2009 and will complete the program in March 2011.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Complete all FY 2010 planned actions for the FY 2008-FY 2010 NASA Model EEO Agency Plan.	None	None	None	10WF01 Green
Complete development of the Agency strategy for deployment of a diversity and inclusion framework.	None	None	None	10WF02 Green
Complete implementation of a certification program to ensure that Program and Project Managers meet Federal Acquisition Certification Requirements before or within one year of assuming leadership of major acquisition projects.	None	None	None	10WF03 Green
Complete full roll-out of the new mid-level leadership development program, targeted at the GS13 through GS15 levels, to ensure continued development of a cadre of potential future NASA leaders and support succession management efforts.	None	None	None	10WF04 Green
Engage with the Mission Directorates, Centers, and Mission Support offices in the development of a 5-year workforce plan, matching workforce capabilities with mission needs. Eliminate unassigned civil service workforce in all years of the planning horizon.	None	None	None	10WF05 Green
By March 2010, complete Phase 4 of Shuttle Transition workforce mapping to identify final detailed Shuttle workforce composition and disposition issues and any required actions.	None	None	None	10WF06 White

Why NASA rated APG 10WF06 White: NASA completed the first three phases of this effort (approximately 80 to 85 percent of the goal) but has stopped work on Phase Four that is specific to mapping Shuttle workforce to Constellation program activities. The NASA Authorization Act of 2010 and final FY 2011 Appropriations will provide further direction concerning future NASA programs. NASA can then restart the mapping exercise from current to future programs. NASA recognizes the need for mapping its Shuttle workforce to activities consistent with that future direction.

Outcome AS.3: Ensure the strategic availability and maintenance of facilities which are necessary to meet the long-term needs and requirements of the Agency.

FY07	FY08	FY09	FY 2010
None	None	None	Green

Ensuring that NASA's assets operate at peak capacity and efficiency

The Office of Strategic Infrastructure (OSI) assures the timely availability of infrastructure assets and capabilities by reducing the current and future infrastructure related risks to the Agency. OSI accomplishes its mission through effective management of existing infrastructure, enhanced institutional planning and decision-making, proactive deployment of sustainable practices, and disciplined risk management.

In FY 2010, OSI worked with each NASA Center to update their Master Plans for real property and reviewed critical facilities across the Agency to maximize operational capacity and achieve greater efficiencies. For example, during FY 2010, an independent facility review of the V20 and the Sunspot Thermal Vacuum Chamber at Marshall Space Flight Center (MSFC) identified a number of critical safety related concerns that required mitigation. MSFC, using matching funds from the Strategic Capabilities Assets Program within the OSI Technical Capabilities and Real Property Division took immediate action and facilitated the necessary repairs.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Assure that at least 50% of the NASA Centers have updated their Master Plans to implement Agency Strategic Direction from the Facilities Program Board.	None	None	None	10FAC01 Green
Perform a test case review of one of the Agency's major technical portfolios to determine consolidations and/or investments.	None	None	None	10FAC02 Green
Conduct a facility requirements review for the Altair Project requirements through qualification testing.	None	None	None	10FAC03 White

Why NASA rated APG 10FAC03 White: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.

Outcome AS.4: While promoting mission success, protect the public, NASA workforce, high-value equipment and property from potential harm as a result of NASA activities and operations by factoring safety, quality, risk, reliability, and maintainability as integral features of programs, projects, technologies, operations, and facilities.

FY07	FY08	FY09	FY 2010
None	None	None	Yellow

Safety is their mission

The Safety and Mission Success (SMS) program administers and refines policies, procedural requirements, and technical standards for NASA. SMS program activities are a key component of the forums that provide advice to the Administrator, Mission Directorates, Program Managers and Center Directors who are ultimately accountable for the safety and mission success of all NASA programs, projects, and operations. The SMS program provides an effective NASA Engineering and Safety Center, NASA Safety Center, and Independent Verification and Validation Facility as established and recognized components of a comprehensive response to lessons learned from NASA's greatest tragedies. These organizations form a basis for a disciplined execution of safety, reliability, quality and system engineering needed for the successful pursuit of NASA's missions. SMS resources provide the foundation for NASA's system of "checks and balances" enabling the effective application of NASA's technical authorities and strategic management framework. With this funding, discipline experts judge the criticality of the associated risk and evaluate the risk acceptability through an established process of independent review and assessment. The information and advice from these experts is critical for developing key decision information for the proper execution of the delegated technical authority applied at program and project decision forums.

Why NASA did not achieve Outcome AS.4: There were 12 permanent partial disability (Type B) mishaps that occurred to contract employees during FY 2010.

Plans for achieving Oucome AS.4: Policy and procedures are currently in place to provide guidance and education to the NASA workforce (civil service and contractor employees) to minimize mishaps. Management is provided an out brief after each Type A or B mishap with the goal of disseminating information that will reduce the potential for future occurrences.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Assure no fatalities or permanent disabling injuries to the public resulting from NASA activities during the fiscal year.	None	None	None	10SMS01 Green
Assure no fatalities or permanent disabling injuries to the NASA workforce resulting from NASA activities during the fiscal year.	None	None	None	10SMS02 Red
Reduce damage to NASA assets by 10% per fiscal year.	None	None	None	10SMS03 Green

Why NASA did not achieve APG 10SMS02: There were no fatalities or permanent, total disabilities (Type A) to the NASA workforce during the fiscal year. However, there were 12 permanent partial disability (Type B) mishaps that occurred to contract employees. This was an increase compared to the previous year. There were no Type A or B injuries to NASA civil service employees. NPR 8621.1 defines a Type A mishap as a permanent total disability and Type B as an occupational injury and/or illness that has resulted in a permanent partial disability.

Plans for achieving 10SMS02: Policy and procedures are currently in place to provide guidance and education to the NASA workforce (civil service and contractor employees) to minimize mishaps. Management is provided an out brief after each Type A or B mishap with the goal of disseminating information that will reduce the potential for future occurrences.

Outcome AS.5: Implement the space communications and navigation architecture and provide space launch capabilities responsive to existing and future science and space exploration mission requirements.

FY07	FY08	FY09	FY 2010
None	None	None	Green

NASA's communication networks continue to deliver

An uninterrupted, reliable communications and navigation network is essential to receive and transmit the data that makes NASA missions safe, efficient, and successful. Currently, NASA's communications network consists of three main elements: the Space Network, the Near-Earth Network, and the Deep Space Network. NASA's Goddard Spaceflight Center leads and operates the Space and Near-Earth Networks and the Jet Propulsion Laboratory operates the Deep Space Network. These networks provide communications and tracking to all orbiting NASA assets, everything from the International Space Station to spacecraft orbiting Earth and traveling out to the very edge of the solar system.

However, operating these networks has become increasingly more expensive, which has motivated NASA to investigate potentially more cost-effective solutions. In FY 2010, NASA's Space Communications and Navigation (SCaN) program continued its development of a unified space communication and navigation network capable of meeting both robotic and human exploration needs. To this end, NASA awarded a contract which will provide major modernization upgrades to the Space Network Ground Segment (SGSS) as well as the architectural basis for further integration of the SCaN networks towards a single, integrated network. Likewise, NASA addressed Deep Space Network facility issues by releasing a Request for Proposal for 70 meter Antenna Replacement project with award anticipated in early FY 2011.

In FY 2010, ScaN's Communication, Navigation and Networking, reConfigurable Testbed (CoNNeCT) and its Lunar Laser Communication Demonstration (LLCD) technology projects successfully completed Critical Design Reviews, which are one-time programmatic events that bridge the design and manufacturing stages of a project. A successful review means that the design is validated, will meet its requirements, and has been proven to be safe. The LLCD is an experiment to provide the proof-of-concept for laser-based communications from lunar orbit, which could result in overall cost savings on the ground and in space, while providing more capability. It is a significant step for the Agency in becoming more efficient with its limited resources.

The Space Network supported missions this year at or above 99.9 percent proficiency, exceeding requirements. Key missions supported include the Space Shuttle, International Space Station, Hubble Space Telescope, and the Terra Earth science mission. The Deep Space Network-supported missions this year at or above 95 percent proficiency for both telemetry and command, also exceeding requirements. Key missions supported include Cassini, Kepler, Mars Reconnaissance Orbiter, and Mars Exploration Rovers. The Near Earth Network supported missions this year at or above 99.1 percent proficiency, above requirements. Key missions supported include the LRO, Solar-B, Aqua, and Aura missions.

NASA Preparing for the Next Generation of Rockets

NASA's Rocket Propulsion Test (RPT) activities continued to support the Agency's core capabilities and needs. Efforts continue through the National Rocket Propulsion Test Alliance (NRPTA) to identify NASA, Department of Defense, and commercial capabilities and requirements over the next 10 years. The results will be identified in the NASA RPT Master Plan due to be released at the end of calendar year 2010. Over the next year, RPT will begin the implementation of recommendations from the 2009–2010 White Sands Test Facility capabilities study as part of its responsibilities to maintain Agency RPT core capabilities (both infrastructure and critical skills) at appropriate levels to be able to meet NASA's current and future rocket testing requirements.

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Complete the assessment of Array Antenna size in support of the long-term plans for the 70 meter antenna decommissioning and replacement.	None	None	None	10SFS06 Green
Complete TDRS K/L Project Mission Operations Review (MOR).	None	None	9SFS6 Green	10SFS07 Yellow
Complete SN Ground Segment Sustainment project (SGSS) Mission Definition Review.	None	None	None	10SFS08 Yellow
Identify agency rocket propulsion test core capabilities (both infrastructure and critical skills) and maintain them at appropriate levels to be able to meet NASA's current and future rocket testing requirements, and deliver an integrated Agency-level Rocket Propulsion Test Plan that spans the next 10 years and includes DoD and commercial partner requirements and capabilities, as appropriate.	None	None	9SFS4 Yellow	10SFS09 Yellow
Maintain or acquire launch services capabilities (both infrastructure and skills) at levels needed to meet NASA's current and future launch services requirements efficiently and effectively.	None	None	None	10SFS10 Green
Complete 100% of Launch Service objectives for all NASA-managed expendable launches in FY 2010 as specified in the Interface Control Document for each mission.	None	None	None	10SFS11 Green

Why NASA did not achieve APG 10SFS07: The TDRS project had originally scheduled the K/L MOR for September 2010 but was delayed to resolve minor conflicts involving resources.

Plans for achieving 10SFS07: The MOR will be held in November 2010.

Why NASA did not achieve APG 10SFS08: The SGSS Mission Definition Review did not occur as planned due to an ongoing contractor protest.

Plans for achieving 10SFS08: NASA will develop a new plan and schedule for completing the Mission Definition Review once the protest is adjudicated.

Why NASA did not achieve 10SFS09: The Agency-level Rocket Propulsion Test Plan due date was re-negotiated and agreed upon between NASA and the Office of Management and Budget; new due date is December 31, 2010.

Plans for achieving 10SFS09: The Rocket Propulsion Test Plan is on schedule to meet the December 31, 2010, deadline.

NASA's Uniform and Efficiency Measures

NASA uses Uniform and Efficiency Measure APGs to track performance in a number of program and project management areas, including life cycle schedule and cost and competitive award processes. NASA organizes the Efficiency Measure APGs by Theme to emphasize and encourage individual program accountability.

34 APGs			
Green	Yellow	Red	White
22	1	7	4

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Advanced Capabilities Theme				
Complete all development projects within 110% of the cost and schedule baseline.	None	None	9AC18 Yellow	10AC19 White
Why NASA rated APG 10AC19 White: There were no projects in development in the Advanced Capabilities Theme in FY 2010, and none are planned for FY 2011.				
Demonstrate improvements in the EVA Work Efficiency Index for astronauts using a small, pressurized rover with suit-ports compared to astronauts using an unpressurized rover. Work efficiency index = (time to complete a task)/(total time to prepare for EVA).	None	None	9AC20 Green	10AC20 Green
Aeronautics Theme				
Deliver at least 96% of "on-time availability" for all operations and research facilities.	7AT8 Yellow	8AT17 Yellow	9AT12 Green	10AT13 Green
Agency Support				
Reduce energy intensity for facility energy use by 3% per year, from the FY 2003 baseline, for a total reduction of 30% (in Btu/gsf) by the end of FY 2015.	None	None	None	10FAC04 Red
Why NASA did not achieve APG 10FAC04: Energy intensity is decreasing an average of 1 percent annually, and energy unit costs are increasing an average of 7.2 percent annually. *Plans for achieving APG 10FAC04:* NASA is working to meet energy intensity reduction requirements of 3 percent per year and 30 percent by 2015, from the FY 2003 baseline. In an effort to assist Centers to administer their energy management programs, NASA Headquarters conducts Energy and Water Management Functional Reviews at a third of NASA Centers annually to help Centers in improving their management systems and identifying and implementing energy conservation measures. In FY 2010, NASA invested $66 million for construction and revitalization projects at four NASA Centers that include major replacements of aging high energy use equipment with new energy efficient units, and initiated an Inter-Center Competition to reduce energy/water consumption. The competition encourages Centers to implement low-cost and no-cost initiatives to reduce energy and water usage. NASA will allocate $4 million of Strategic Institutional Investment funds for small energy and renewable projects in FY 2011 and an additional $22.3 million in FY 2012. This past fiscal year, NASA also initiated a Recapitalization Program that will replace aging facilities with new more energy efficient buildings.				
Reduce total fleet consumption of petroleum products by 2% per year, from the FY 2005 baseline, for a total of reduction of 30% by the end of FY 2020.	None	None	None	10FAC05 Green
Reduce potable water use by 2% per year, from the FY 2007 baseline, for a total reduction of 26% (in gal/gsf) by the end of FY 2020.	None	None	None	10FAC06 Green
Achieve a number of technology commercialization successes from SBIR/STTR Phase II contracts through FY 2010 to equal 21% of the total number of SBIR/STTR contracts issued over the prior 5 years, including FY 2010.	None	None	None	10IPP08 Green

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Complete all development projects within 110% of the cost and schedule baseline.	None	None	None	10IT11 Red
Why NASA did not achieve APG 10IT11: All but one project finished within the required 110 percent of cost and schedule baselines. The Security Operations Center (SOC) implementation (Phase-2) project has undergone schedule slips, due to delays in facilities power modifications resulting in delays of receiving IT Security event data from numerous sources across the Agency. The delay in having adequate power to the facility kept the SOC from being able to capture data, thereby not allowing testing and not being ready to complete the ORR. The extra power lines and resultant coordination were not planned for when the project was initially scoped and were beyond the initial project plan estimates. The final SOC implementation plan will increase cost to 145 percent and schedule to 161 percent of the initial project scope. NASA reviewed this project during implementation, and given the importance of IT security, approved additional time and funding for the project.				
Plans for achieving APG 10IT11: There are no options to achieving this goal. NASA determined the IT Security Operations Center project implementation fits into the CyberSecurity scope and needed to be accomplished to protect NASA's IT vulnerability.				
In 2010, reduce the amount of system execution time during the year-end close process by six hours.	None	8IEM07 Red	9IEM9 Red	10IT12 Green
Deliver at least 90% of scheduled operating hours for all operations.	None	None	None	10IT13 Green
Using the Agency's Staffing and Recruitment System, NASA STARS, complete hiring actions—from date of vacancy announcement closing to the time an offer is made—within 45 days.	None	None	None	10WF07 Green
Astrophysics Theme				
Complete all development projects within 110% of the cost and schedule baseline.	7UNIV9 Red	8AS09 Yellow	9AS12 Yellow	10AS11 Green
Deliver at least 90% of scheduled operating hours for all operations and research facilities.	7UNIV10 Green	8AS10 Green	9AS13 Green	10AS12 Green
Peer-review and competitively award at least 95%, by budget, of research projects.	7UNIV11 Green	8AS11 Green	9AS14 Green	10AS13 Green
Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.	7UNIV12 Green	8AS12 Yellow	9AS15 Green	10AS14 Green
Constellation Systems Theme				
Complete all development projects within 110% of the cost and schedule baseline.	7CS9 White	8CS14 White	9CS14 White	10CS13 White
Why NASA rated APG 10CS13 White: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.				
Total annual cost of Constellation operations activities for the first full year after full operational capability, will be no greater than 70% of comparable annual Shuttle operations costs (reference year FY 2007).	None	8CS15 Green	9CS13 White	10CS14 White
Why NASA rated APG 10CS14 White: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.				

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Earth Science Theme				
Complete all development projects within 110% of the cost and schedule baseline.	7ESS21 Yellow	8ES15 Yellow	9ES21 Red	10ES17 Red
Why NASA did not achieve APG 10ES17: NASA did not complete the Glory and Aquarius missions within 10% of their cost and schedule baselines.				
Plans for achieving APG 10ES17: The Glory mission experienced significant cost and schedule growth due primarily to the failure of the Orbiting Carbon Observatory (OCO) Taurus XL launch vehicle and issues with the vendor's production of acceptable boards for the Maxwell Single Board Computers. Glory's current projected lifecycle cost is 68 percent higher than the baseline established at Confirmation Review. The mission is tentatively scheduled for a February 2011 launch readiness date, a 72 percent increase in schedule. The Aquarius launch readiness date has been rescheduled for April 2011 due to delays in the development of the international partner's Mission Operations System. The schedule for the mission has increased by 60 percent, but the lifecycle cost remains within 15 percent of the baseline.				
Deliver at least 90% of scheduled operating hours for all operations and research facilities.	7ESS22 Green	8ES16 Yellow	9ES22 Green	10ES18 Green
Peer-review and competitively award at least 90%, by budget, of research projects.	7ESS23 Green	8ES17 Green	9ES23 Green	10ES19 Green
Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 227 days.	7ESS24 Red	8ES18 Green	9ES24 Red	10ES20 Yellow
Why NASA did not achieve APG 10ES20: The time within which 80 percent of the Earth Science selection notifications were made decreased in FY 2010 to 231 days, but fell just short of the ultimate goal of 227 days, which it was scheduled to achieve this fiscal year.				
Plans for achieving APG 10ES20: The Science Mission Directorate continues to implement changes to reduce delayed selection notifications. These include the scheduling of proposal due dates to spread out the work for the understaffed research program managers and providing tentative notification to proposers when budget uncertainty (e.g., lack of appropriations, lack of operating plan) delays final decision authority.				
Education Theme				
Reduce the dollar invested per number of page views for the NASA Education Web site.	None	None	9ED13 Green	10ED11 Green
Reduce the cost per elementary and secondary school program participant over FY 2009 amounts by 2%.	None	None	9ED14 Red	10ED12 Red
Why NASA did not achieve APG 10ED12: Research in science, technology, engineering, and mathematics (STEM) education shows that projects and activities that provide hands-on experiences, intensive internships, and sustained educator professional development relationships are more effective in positively affecting STEM teaching and learning. NASA's Office of Education has strategically adjusted its elementary and secondary portfolio to include greater investments in these types of experiences. They are more costly, but more effective in improving teaching and learning than short-term, broad-based activities like one-time workshops, auditorium-style presentations and school visits. Elementary and secondary education programming is changing direction within a flat-line (or decreasing core program budget), and this goal is no longer feasible.				
Plans for achieving APG 10ED12: This performance goal has been determined to be unattainable as written and will be replace by a more appropriate measure in FY 2011.				
Heliophysics Theme				
Complete all development projects within 110% of the cost and schedule baseline.	7ESS21 Yellow	8HE07 Red	9HE10 Yellow	10HE09 Red
Why NASA did not achieve APG 10HE09: NASA did not complete the Solar Dynamics Observatory (SDO) within 110 percent of cost and schedule baselines. SDO initially slipped from its 2008 firm slot in the launch manifest due to late delivery of avionics boxes and instruments and problems with electronics parts and the high-speed data bus. SDO then experienced difficulty obtaining a new slot in the launch manifest, as no firm slots were available until 2010 due to multiple Atlas V launch vehicle issues and associated launch queue delays.				
Plans for achieving APG 10HE09: NASA launched SDO in February 2010. This exceeded the original schedule by 48 percent, but the mission's lifecycle cost remains within 7 percent of the original cost baseline.				

FY 2010 Annual Performance Goals	FY07	FY08	FY09	FY 2010
Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.	7ESS24 Red	8HE10 Yellow	9HE13 Green	10HE12 Red
Why NASA did not achieve APG 10HE12: The time within which 80 percent of Heliophysics selection notifications were made increased in FY 2010 to 235 days, exceeding the goal of 215 days.				
Plans for achieving 10HE12: The Science Mission Directorate continues to implement changes to reduce delayed selection notifications. These include the scheduling of proposal due dates to spread out the work for the understaffed research program managers and providing tentative notification to proposers when budget uncertainty (e.g., lack of appropriations, lack of operating plan) delays final decision authority.				
International Space Station Theme				
Deliver at least 90% of scheduled operating hours for all operations and research facilities.	7ISS7 Green	8ISS07 Green	9ISS8 Green	10ISS09 Green
Planetary Science Theme				
Peer-review and competitively award at least 95%, by budget, of research projects.	7SSE12 Green	8PS11 Green	9PS13 Green	10PS13 Green
Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.	7ESS13 Red	8PS12 Green	9PS14 Green	10PS14 Red
Why NASA did not achieve APG 10PS14: The time within which 80 percent of Planetary Science selection notifications were made increased in FY 2010 to 243 days, exceeding the goal of 221 days.				
Plans for achieving APG 10PS14: The Science Mission Directorate continues to implement changes to reduce delayed selection notifications. These include the scheduling of proposal due dates to spread out the work for the understaffed research program managers and providing tentative notification to proposers when budget uncertainty (e.g., lack of appropriations, lack of operating plan) delays final decision authority.				
Complete all development projects within 110% of the cost and schedule baseline.	7SSE10 Red	8PS09 White	9PS11 Red	10PS15 White
Why NASA rated APG 10PS15 White: This is a standing uniform efficiency measure that is not applicable in this fiscal year. No Planetary Science missions were scheduled to launch in FY 2010.				
Deliver at least 90% of scheduled operating hours for all operations and research facilities.	7SSE11 Green	8PS10 Green	9PS12 Green	10PS16 Green
Space and Flight Support Theme				
Achieve at least 99% Space Network proficiency for delivery of Space Communications services.	None	8SFS04 Green	9SFS10 Green	10SFS12 Green
Complete all development projects within 110% of the cost and schedule baseline.	7SFS5 White	8SFS06 White	9SFS11 Green	10SFS13 Green
Ratio of Launch Services Program cost per mission to average spacecraft cost, reduced to 6.2%.	None	None	9SFS12 Green	10SFS14 Green
Space Shuttle Theme				
Deliver at least 90% of scheduled operating hours for all operations and research facilities.	7SSP5 Green	8SSP06 Green	9SSP6 Green	10SSP06 Green

NASA's Performance Improvement Plan Update for FY 2009

NASA holds itself accountable for achieving the Performance Improvement Plans set in the previous fiscal year. In FY 2009, NASA rated a total of 38 measures as red or yellow and provided individual Performance Improvement Plans for remedying each performance shortfall. The table below lists each unmet FY 2009 measure, with its performance improvement plan and provides the most recent information on the Agency's efforts to achieve the measures. As a best practice, NASA also will provide a Performance Improvement Plan Update in the FY 2011 PAR to assure the public of the Agency's continued commitment to excellence in performance and accountability.

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
Aeronautics Research Mission Directorate			
Aeronautics			
9AT2 (Outcome 3E.1)			
Conduct a spin test to verify enhanced disk rim attachment strength at component level and show 10% life improvement over criteria established in 2007.	Yellow	The final spin test to validate the performance did not occur prior to the end of FY 2009 because of test facility problems. NASA Glenn Research Center delivered two superalloy disks and an oven to the Space Act Agreement (SAA) partner, who agreed to conduct a Spin Pit Test on the superalloy to see if the disk could withstand 10,000 cycles at 1,300 degrees Fahrenheit. In April 2009, the SAA partner began calibrating the government-provided oven to ensure it maintained an acceptable 1,300 degrees Fahrenheit. During this checkout, the oven did not maintain a stable temperature. As a result, the SAA partner purchased a new oven that was delivered and checked out by July 31, 2009, resulting in a normal two-week shutdown of the test facilities. During calibration on August 10, 2009, the new oven met temperature requirements, but failed due to mechanical reasons. Replacement parts have been ordered, and the checkout of the oven is scheduled for September 8, 2009. The testing period for the superalloy disks is expected to last a couple of weeks, following successful calibration of the oven. While ARMD still expects performance consistent with a green rating and completion of milestone before September 30, 2009. However, since the analysis to support the APG will not be complete until after October 1, 2009, ARMD supports a rating of Yellow.	The test will proceed as planned and analysis will be conducted and completed in the first quarter of FY 2010
FY 2010 Update: NASA completed the spin test during the third quarter of FY 2010. The disk reached the 10,000 dwell cycle goal and achieved a green exit criteria. The redesigned arbor and fixtures performed to specifications enabling the test to be performed at 1300 °F. A post test inspection revealed no radial growth of the disk and no change in the attachment hole dimensions. Following the spin test, the disk was sent to an FAA authorized Non-Destructive Inspection vendor for a Class 3 Fluorescent Penetrant Inspection. No cracks were detected. Final room temperature disk burst test was performed. The predicted burst speed was 80,000 revolutions per minute (rpm) and the disk burst at 80,480 rpm, within 1.0 percent of predicted speed. FEM analysis also correctly predicted location of crack initiation.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9AT10 (Outcome 3E.3)			
Complete the CFD pretest predictions of performance and operability of a high Mach fan for a TBCC propulsion system and compare to fan test data from the GRC W8 facility.	Yellow	NASA completed an extensive test program for the fan of a Mach 4 turbine engine. Researchers used the data from this effort to validate NASA's advanced Computational Fluid Dynamics (CFD) codes for turbine analysis and to validate the NASA and General Electric design methodology. All of the stall margin points, with the exception of one, were well within the APG's Green criteria of a five-percent difference. However, the predictions were outside the pre-established metric. The NASA effort to develop Mach 4 turbine engines is a very significant and challenging advancement to the state-of-the-art. The efficiency goal set by the NASA team of 0.25 percent, is very aggressive, especially considering that this was the first attempt at such predictions for a Mach 4 design. Typical efficiency errors for less complex fans are usually in the range of 0.4 percent to one percent, which is consistent with the results from this high-speed test.	The primary reason that the goal was not met is that NASA set very aggressive metrics, especially for the efficiency predictions. This was done to push the limits of NASA's ability to predict challenging conditions, and should not be interpreted as a failure of the prediction methods. NASA will continue to investigate how prediction capabilities can be improved, based on an analysis of the results and comparison with other state-of-the-art prediction methods on less sophisticated fans. This initial set of experiments and predictions were successful and work is proceeding on more complex testing that permits additional advances. The overall turbine-based combined cycle (TBCC) effort continues with the installation and testing of the TBCC inlet system in the Glenn Research Center 10-by-10-foot Supersonic Wind Tunnel in FY 2010.
FY 2010 Update: The ability to predict the compressor efficiency within 0.4 percent remains the state-of-the art for advanced high-fidelity turbomachinery Computational Fluid Dynamics (CFD) codes. This level of CFD code accuracy was deemed sufficient so that the more relevant distorted inlet flow research on the Mach 4 fan could proceed. The distorted inlet flow case directly supports NASA research for the turbine-based combined cycle (TBCC) effort mentioned previously. Note that the FY 2009 APG 9AT10 addressed the uniform inlet flow case only for the Mach 4 fan. In the future, NASA plans to continue to improve and validate state-of-the-art CFD codes for turbine design and analysis, but this work has not yet been planned for the near-term.			
Exploration Systems Mission Directorate			
Constellation			
Outcome 4.1			
No later than 2015, and as early as 2010, transport three crewmembers to the International Space Station and return them safely to Earth, demonstrating an operational capability to support human exploration missions.	Yellow	As with any major development program in formulation, the Constellation Program continues to perform detailed budget and schedule analysis to ensure that each project's budget and content are optimized to successfully meet the March 2015 Initial Operation Capability (IOC). During the FY 2010 Budget Request cycle, NASA did a replan, which resulted in the realignment of some major milestones. This resulted in a delay in some major milestones reflected in the yellow rating of several FY09 APGs, but preserved the March 2015 IOC date. NASA is currently in the process of reviewing its latest cost and schedule confidence in advance of the Key Decision Point (KDP)-II, which will move the program into the Implementation phase.	In summer 2010, NASA will hold Ares I, Orion, and Ground Operations Key Decision Point C reviews to decide if each are ready to enter development. At this time, Constellation also will go through its second KDP review, allowing the program to enter implementation. The Mission Operations and Extravehicular Activity (EVA) projects will have their PDRs, preparing them for their KDP-C reviews. Additionally, Constellation made significant progress in understanding and integrating project interdependencies, allowing for improved integration of scheduling and helping the program get back on track to achieve the Outcome.
FY 2010 Update: In FY 2010, the Constellation Program completed the Technical Preliminary Design Review (PDR) for Constellation in March 2010, the Ground Operations Project PDR in June 2010, and completed Ares I-X launch test, the Orion Pad Abort-1 test, and the Ares I Development-Motor 2 (DM-2) test.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9CS1 (Outcome 4.1)			
Complete the Critical Design Review (CDR) for the Orion / Crew Exploration Vehicle (CEV).	Red	Constellation established the milestone date used for this APG when the project was still in early formulation. Since then the project's schedule has been refined and the milestone pushed to a later date to align with the Constellation Program's replanned schedule.	The Orion project has been following the schedule set by the Constellation Program. The project continued to perform Design Analysis Cycles through summer 2009, which led to a successful PDR in July and August. The next major milestone on Orion's schedule is the KDP-C review set for summer 2010. The Orion Critical Design Review (CDR) follows that review in FY 2011.
FY 2010 Update: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.			
9CS3 (Outcome 4.1)			
Complete the Critical Design Review (CDR) for the Pad B Launch Complex development within the Ground Operations Project.	Yellow	The Constellation Program changed the Ground Operations Pad B Launch Complex milestone dates in accordance with the program's revised schedule.	NASA plans to hold the CDR for the Pad B Launch Complex in summer 2010.
FY 2010 Update: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.			
9CS4 (Outcome 4.1)			
Complete the Preliminary Design Review (PDR) of the Mission Control Center System (MCCS) within the Mission Operations Project.	Yellow	The Constellation Program changed the Mission Operations project's schedule, and the project did not mature the Mission Control Center System to the point where it could undergo the PDR.	NASA has made it possible for mature subsystems for the Mission Control Center System to proceed with a PDR and then allow those subsystems to begin working toward their CDR. The Mission Operations project will have the entire Mission Control Center System ready for its PDR in summer 2010.
FY 2010 Update: NASA completed PDR of the Mission Control Center System on February 11, 2010. The results of this PDR were incorporated into the Mission Operations Project (MOP) PDR, which was completed August, 17, 2010.			
9CS5 (Outcome 4.1)			
Complete the Preliminary Design Review (PDR) for the Extravehicular Activity (EVA) Space Suit Element for CEV.	Red	The Constellation Program changed the project's schedule when the program did its replan.	As part of the Orion PDR, the Constellation Program identified what was required tomake the EVA spacesuit design work with the Orion spacecraft systems, and the two projects have integrated their hardware development, associated analyses, and related milestones. The EVA Suit Configuration 1 PDR is scheduled for September 2010, which enables the Constellation Space Suit System prime contractor an opportunity to mature the rest of the system.
FY 2010 Update: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9CS6 (Outcome 4.1)			
Complete the launch and flight analysis of the CEV Pad Abort 1 (PA-1) test.	Yellow	Unanticipated difficulties during subscale testing (where the project team test a smaller-scale engineering model) of the Attitude Control Motor (ACM) delayed the Pad Abort-1 (PA-1) flight test.	Due to the difficulties during testing, the project changed the design. Two successful subscale test firings with the new design indicated that the project has overcome the challenges. A full-scale test firing of the ACM is scheduled for fall 2009, and the Orion project remains on track to conduct the PA-1 test in early 2010. These tests are for a Launch Abort System that will allow the crew to jettison clear of the Ares I rocket in case of emergency before launch. This is a safety feature that has not been available on NASA's previous space transportation systems.
FY 2010 Update: The program conducted the CEV Pad Abort 1 test flight on May 5, 2010. Launch and flight analysis concluded that all flight test objectives were met.			
9CS7 (Outcome 4.1)			
Complete the launch and flight analysis of the Ares 1-X sub-orbital test.	Yellow	The Ares I-X flight test was delayed primarily due to vendor component manufacturing delays, changes to the availability of Space Shuttle Program assets (see Outcome 4.2), and the complexities of loads analyses and certification.	The vendors have delivered all the components for the Ares I-X flight test vehicle to Kennedy Space Center, and the vehicle has been stacked. The project is testing the integrated vehicle elements. In May 2009, the Shuttle Program turned over Pad 39B to the Ares I-X team, following the STS-125 Shuttle mission, and the Ares project began modifying the pad. The flight test occurred in early FY 2010. The project will analyze the flight data and apply it to Ares I computational models, and will continue this task into mid-2010.
FY 2010 Update: NASA conducted the Ares I-X test flight on October 28, 2009. Subsequent launch and flight analysis concluded that all flight test objectives were met.			
9CS9 (Outcome 5.2)			
Have at least one Partner complete a minimum of one orbital demonstration flight in FY 2009.	Yellow	NASA did not meet the stated APG in FY 2009, but is on track to complete it in FY 2010. During FY 2009, SpaceX notified NASA of delays associated with the maiden launch of its Falcon 9 launch vehicle flight, which impacted their ability to maintain the current launch dates for the NASA COTS demonstration missions. SpaceX has replanned its work and has committed to fly all three COTS demonstration missions in 2010. NASA continues to work closely with SpaceX to provide technical assistance and monitor progress.	The first COTS orbital flight demonstration is now planned for early 2010 and NASA expects that the goals of the program will be met.
FY 2010 Update: SpaceX successfully launched its Falcon 9 spacecraft on June 4, 2010, and is proceeding toward its first COTS demonstration flight in December 2010.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9CS11 (Outcome 6.5)			
Conduct the Lunar Capabilities SRR to define the lunar mission architecture transportation requirements.	Red	NASA did not hold the Lunar Capabilities System Requirements Review (SRR) in FY 2009. NASA established these performance measures while the project was in early formulation.	NASA has scheduled the Lunar SRR for early 2010. NASA replanned the project to reconcile with the availability of funds, and to identify an achievable schedule, with its FY 2010 budget request. However, NASA will re-examine this new project plan after the Review of U.S. Human Spaceflight Plans Committee (also known as the Augustine Committee) releases its final report.
FY 2010 Update: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.			
9CS12 (Outcome 4.1)			
Complete the Preliminary Design Review (PDR) for the Constellation Program flight capability (PDR #1).	Yellow	Constellation established the milestone date used for this APG when the program was still in early formulation. Since then, the program refined its schedule in preparation for the FY 2011 budget request.	Constellation's projects contributing to the flight capability have been realigned to the new schedule. The PDR is scheduled for spring 2010.
FY 2010 Update: In the FY 2011 budget process, the President proposed to Congress that the Constellation Program be transitioned to a new set of programs, and NASA adjusted its spending on the program consistent with its budget request and with the Appropriation provided by Congress for FY 2010. NASA has continued its work on Constellation, but reductions in planned work content were made to ensure availability of funds required to complete work already under contract. These reductions have made it difficult for NASA to achieve some of the Constellation Program-related goals and outcomes planned for FY 2010. While NASA determines how to best transition the Constellation Program, consistent with the NASA Authorization Act of 2010 and its FY 2011 Appropriations Act when final, NASA remains poised to leverage Constellation assets to contribute to future exploration beyond low Earth orbit.			
Advanced Capabilities			
Outcome 3F.1			
By 2008, develop and test candidate countermeasures to ensure the health of humans traveling in space.	Yellow	The Lunar Analog Bedrest Pilot Study (LAPS), a 21-day bed rest study designed to simulate the effects of living on the Moon, was delayed in September 2008 because Hurricane Ike prevented access to the facility.	LAPS resumed operations in April 2009, with the final subject finishing the study in August. Project researchers completed analysis of the data in September. LAPS Phase 2 will commence in November 2009 with completion in May 2010. With completion of this project, and APG 9AC5, Outcome 3F.1 will be back on schedule.
FY 2010 Update: NASA initiated the Lunar Analog Feasibility Study (LAFS) to assess the feasibility and subject comfort of the Lunar Gravity Simulator. In September 2008, Hurricane Ike delayed facility access to continue the study. LAFS operations resumed in October 2008 and completed tests in August 2009. NASA finished the subject data assessment in November 2009 and held a workshop in December 2009 to review the results and evaluate the proposed Lunar Analog Pilot Study (LAPS) as a bed rest research platform for future lunar analog studies. In February 2010, NASA reviewed the conclusions and recommendations from the workshop and made the decision to discontinue the lunar analog due to difficulties related to validation of this model.			
9AC5 (Outcome 3F.1)			
Validate a ground analog fractional-gravity test methodology to assess whether 1/6th g is protective of physiological systems, including bone loss, and if not, what countermeasures are needed	Yellow	This APG relied on completion of LAPS, which was delayed because Hurricane Ike prevented access to the facility.	LAPS resumed operations in April 2009, with the final subject finishing the study in August. Project researchers completed analysis of the data in September. LAPS Phase 2 will commence in November 2009 with completion in May 2010.
FY 2010 Update: NASA initiated the Lunar Analog Feasibility Study (LAFS) to assess the feasibility and subject comfort of the Lunar Gravity Simulator. In September 2008, Hurricane Ike delayed the facility access required to continue the study. LAFS operations resumed in October 2008, and tests were completed in August 2009. NASA finished the subject data assessment in November 2009, and held a workshop in December 2009, to review the results and evaluate the proposed Lunar Analog Pilot Study (LAPS) as a bed rest research platform for future lunar analog studies. In February 2010, NASA reviewed the conclusions and recommendations from the workshop and made the decision to discontinue the lunar analog due to difficulties related to validation of this model.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9AC7 (Outcome 3F.2)			
Evaluate three alternative distillation technologies for primary water processing as part of closed loop water recovery systems.	Yellow	NASA did not complete the evaluation of the third alternative distillation technology by the end of September 2009 because of manufacturing difficulties.	The NASA will complete the testing by October 13, 2009. The final report comparing the three technologies will be completed by the first quarter of FY 2010.
FY 2010 Update: NASA completed testing of the third alternative distillation technology in October 2009. NASA finished test analysis in January 2010, and on April 29, 2010, released an independent review panel report, which compared distillation technologies and provided recommendations.			
9AC18 (Efficiency Measure)			
Complete all development projects within 110% of the cost and schedule baseline.	Yellow	While the LRO, LCROSS and the VCAM projects were within their cost baselines, they did not comply with the 110 percent schedule baseline. For LRO and LCROSS, there were technical problems with the launch vehicle systems which contributed to the launch delays. For VCAM, there were technical problems encountered in the development of the instrument which resulted in the schedule delay.	LRO and LCROSS were launched on June 18, 2009, and the VCAM successfully completed its pre-ship review on August 26, 2009.
FY 2010 Update: While this efficiency was rated yellow in FY 2009 because three projects did not meet schedule baselines, the corresponding efficiency measure for FY 2010 (10AC19) is rated green. ESMD successfully completed all development projects within 110 percent of cost and schedule baselines.			
Science Mission Directorate			
Earth Science			
9ES3 (Outcome 3A.1, 3A.5)			
Develop missions in support of this Outcome, as demonstrated by completing the Glory mission Launch Readiness Review (LRR).	Red	NASA did not complete Glory's Launch Readiness Review due to the failure of the OCO Taurus XL, in addition to issues with the vendor's production of acceptable boards for the Maxwell Single Board Computers. Unfortunately, the team determined that the 24-layer circuit boards originally chosen for the project could not be reliably manufactured, and they are pursuing an alternate design. As a result of both issues, the project has delayed the Launch Readiness Date by 17 months.	The project has switched to an alternate design for the circuit boards and is now working toward a Launch Readiness Review in November 2010. As mentioned above, the Glory launch date will be subject to the completion of the activities required to approve launch of the Taurus XL.
FY 2010 Update: The circuit boards were completed successfully with the alternate design. However, NASA has set a new launch date of February 2011 for the Glory mission. The new launch date will allow for: 1) closure of the Taurus XL launch vehicle's Return to Flight (RTF) activities, 2) further risk reduction related to spacecraft subsystems, and 3) resolution of launch range manifest conflicts with other scheduled launches.			
9ES5 (Outcome 3A.1)			
Develop mission in support of this Outcome, as demonstrated by completing the CLARREO advanced concepts study.	Yellow	The date for the CLARREO Mission Concept Review was shifted to be consistent with the mission's FY 2010 through FY 2012 funding profile.	The Mission Concept Review, successful completion of which represents completion of the CLARREO advanced concepts study, is scheduled for mid-FY 2010.
FY 2010 Update: In response to the President's Climate Initiative, NASA reprioritized its Earth Science missions and allocated new funding profiles. According to this new plan, the CLARREO mission scope and concept is being redefined within a cost cap and with a target launch readiness date of 2018. The study team is in the process of finalizing the concept design, and the Mission Concept Review is currently scheduled for November 2010.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9ES8 (Outcome 3A.2, 3A.4)			
Develop missions in support of this Outcome, as demonstrated by completing the Global Precipitation Mission (GPM) Confirmation Review.	Yellow	NASA did not complete the GPM Confirmation Review. NASA delayed the GPM confirmation review as a result of an incompatibility between the independent cost estimate developed by the Standing Review Board and the available budget. The project and the Science Mission Directorate have developed an approach and will present it to the Agency for approval at the Confirmation Review.	The Confirmation Review is scheduled to be completed in December 2009.
FY 2010 Update: The project completed the Confirmation Review in December 2009, and is currently scheduled for launch in 2013.			
9ES11 (Outcome 3A.3, 3A.6)			
Develop missions in support of this Outcome, as demonstrated by completing the Landsat Data Continuity Mission (LDCM) Critical Design Review (CDR).	Yellow	NASA did not complete the LDCM CDR in FY 2009. At Initial Confirmation Review, the Standing Review Board recommended that LDCM's launch readiness date, which was seen as being too aggressive, be changed. The CDR was rescheduled accordingly.	The LDCM CDR is currently scheduled for mid-FY 2010.
FY 2010 Update: Earth Science adjusted the LDCM mission schedule in response to the SRB's concerns, and the CDR was completed on May 24, 2010.			
9ES12 (Outcome 3A.3, 3A.6)			
Develop missions in support of this Outcome, as demonstrated by completing the DESDynI advanced concept study.	Yellow	The date for the DESDynI Mission Concept Review was shifted to be consistent with the mission's FY 2010 through FY 2012 funding profile.	The Mission Concept Review, successful completion of which represents completion of the DESDynI advanced concepts study, is scheduled for mid-FY 2010.
FY 2010 Update: In response to the President's Climate Initiative, NASA reprioritized its Earth Science missions and allocated new funding profiles. According to this new plan, the DESDynI mission scope and concept is being redefined within a cost cap and with a target launch readiness date of October 2017. The study team is in the process of finalizing the concept design, and the Mission Concept Review is currently scheduled for early 2011.			
9ES16 (Outcome 3A.5)			
Develop mission in support of this Outcome, as demonstrated by completing the ICESat II advanced concepts study.	Yellow	NASA did not complete the ICESat-2 Mission Concept Review, which represents successful completion of the advanced concepts study.	The February 2009 Mission Concept Review demonstrated inadequate reconciliation of science requirements and mission cost. During the following eight months, the mission implementation approach was refined to meet science objectives within mission cost. The Delta-Mission Concept Review was completed successfully on November 3, 2009.
FY 2010 Update: The mission implementation approach was refined to meet science objectives within mission cost, and the Delta-Mission Concept Review was completed successfully on November 3, 2009.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9ES21 (Efficiency Measure)			
Complete all development projects within 110% of the cost and schedule baseline.	Red	NASA did not complete the Glory mission and the Orbiting Carbon Observatory (OCO) within 10 percent of their cost and schedule baselines. The Glory mission has experienced significant cost and schedule growth due to the failure of the OCO Taurus XL launch vehicle and issues in the vendor's production of acceptable boards for the Maxwell Single Board Computers (SBC). Glory's current projected lifecycle cost is 68 percent higher than the baseline established at the Confirmation Review. The project is currently working toward a November 2010 launch readiness date, a 64 percent increase in schedule. The OCO mission, which was lost in February 2009 due to a launch vehicle failure, slightly exceeded the thresholds, experiencing a 12 percent schedule delay and a 14 percent cost increase.	The Glory mission is currently scheduled for launch in November 2010.
FY 2010 Update: NASA has set a new launch date of February 2011 for the Glory mission. The new launch date will allow for: 1) closure of the Taurus XL launch vehicle's Return to Flight (RTF) activities, 2) further risk reduction related to spacecraft subsystems, and 3) resolution of launch range manifest conflicts with other scheduled launches. The February 2011 launch date represents a 72 percent increase from the baseline schedule, with the lifecycle cost exceeding the baseline by 68 percent.			
9ES24 (Efficiency Measure)			
Reduce time within which eighty percent of NRA research grants are awarded, from proposal due date to selection, by five percent per year, with a goal of 130 days.	Red	The time-span in which 80 percent of Earth Science selection notifications were made increased during FY 2009. A small number of programs with long notification times, about 35 percent of proposers affected resulted in the lack of improvement in Earth Science notifications. The bulk of notifications are being made more quickly; the median notification time has shown average sustained improvement of six percent per year since FY 2005. In FY 2009, staff turnover, and the need to clear the books of overdue selection notifications from FY 2008, also impacted Earth Science.	Changes being made to reduce delayed selection notifications include scheduling proposal due dates to spread out the work for the understaffed research program managers and providing tentative notifications to proposers when budget uncertainty (e.g., lack of appropriations, lack of operating plan) delays final decision authority.
FY 2010 Update: The time within which 80 percent of Earth Science selection notifications were made decreased significantly from FY 2009 to FY 2010, from 260 days to 231 days. Better distribution of proposal due dates contributed to this improvement.			
Heliophysics			
9HE10 (Efficiency Measure)			
Complete all development projects within 110% of the cost and schedule baseline.	Yellow	NASA did not complete the Solar Dynamics Observatory (SDO) within 110 percent of cost and schedule baselines. SDO initially slipped from its 2008 firm slot in the launch manifest due to late delivery of avionics boxes and instruments, and problems with electronics parts and the high-speed data bus. SDO has since experienced difficulty obtaining a new slot in the launch manifest, as no firm slots were available until 2010 due to multiple Atlas V launch vehicle issues and associated launch queue delays.	SDO is currently scheduled to launch in February 2010. This exceeds the original schedule by 48 percent, but the mission is still expected to be completed within 10 percent of the original cost baseline.
FY 2010 Update: NASA launched the Solar Dynamics Observatory in February 2010. This exceeded the original schedule by 48 percent, but the mission's budget remains within 7 percent of the original cost baseline.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
Astrophysics			
9AS5 (Outcome 3D.2, 3D.3)			
Develop missions in support of this Outcome, as demonstrated by beginning Stratospheric Observatory for Infrared Astronomy (SOFIA) open-door testing.	Yellow	The vendor was late delivering the telescope cavity door controller, causing the delay in testing. The telescope cavity door controller opens and closes a 25-foot-long door on a highly modified 747 aircraft and is, therefore, a flight safety critical system. NASA uncovered technical and quality issues with the controller work at the vendor's facility, requiring NASA project management to station representatives at the facility to oversee the final work leading to the late delivery. This led to a delay in the integration and testing of the controller on the aircraft, and consequently the delay in the open-door flight testing.	The open-door flight testing is scheduled to begin in FY 2010.
FY 2010 Update: The plan was successful. NASA stationed representatives at the vendor's facility to oversee the final work leading to delivery of the telescope cavity door controller. The first open-door flight test was completed in December 2009.			
9AS12 (Efficiency Measure)			
Complete all development projects within 110% of the cost and schedule baseline.	Yellow	NASA did not complete the Kepler mission within 10 percent of its cost and schedule baselines. The Kepler prime contractor and many of its sub-contractors were not able to execute planned activities within the cost and schedule they had proposed. One of the major challenges was the focal plane array integration. The focal plane on Kepler, with 42 large CCDs, is the largest ever flown in space and has stringent requirements on science performance. Although management changes were made and other actions taken to address issues, the schedule for the focal plane array took longer, and hence cost more, than originally planned. Launch manifest conflicts also contributed to the 24 percent schedule delay and 18 percent cost increase.	NASA launched the Kepler mission on March 6, 2009.
FY 2010 Update: This action is closed due to the successful launch of the Kepler mission on March 6, 2009.			
Planetary Science			
9PS4 (Outcome 3C.1, 3C.2, 3C.3, 3C.4)			
Develop missions in support of this Outcome, as demonstrated by completing the Mars Science Laboratory (MSL) Launch Readiness Review (LRR).	Red	MSL did not complete the Launch Readiness Review. Development problems with electronic and mechanical devices resulted in slipping MSL's launch to the next Mars launch window in October through December 2011.	NASA re-baselined MSL for launch in the October through December 2011 timeframe. The Launch Readiness Review has been rescheduled to support the new launch period in the first quarter of FY 2012.
FY 2010 Update: The Launch Readiness Review remains scheduled for the first quarter of FY 2012.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9PS11 (Efficiency Measure)			
Complete all development projects within 110% of the cost and schedule baseline.	Red	NASA did not complete the Mars Science Laboratory (MSL) within 10 percent of its cost and schedule baselines. Development problems with critical electronic and mechanical devices resulted in delaying MSL's launch to the next Mars launch window in October-December 2011. This represents a 70 percent schedule increase, with an associated cost increase of approximately 46 percent.	MSL is currently scheduled to launch in November 2011.
FY 2010 Update: MSL is currently scheduled to launch in the first quarter of FY 2012, with the launch window opening in November 2011. This represents a 70 percent schedule increase, with an associated cost increase of approximately 46 percent.			
Space Operations Mission Directorate			
Space Shuttle			
9SSP3 (Outcome 1.2)			
A 13 percent reduction in Space Shuttle annual value of Shuttle production contracts for Orbiter, External Tank, Solid Rocket Boosters, Reusable Solid Rocket Motor, Space Shuttle Main Engine and Launch & Landing, while maintaining safe flight.	Yellow	NASA maintained production capability to comply with the 2008 NASA Authorization Act, which directed NASA to not take any actions before April 30, 2009 that would preclude extending Shuttle flights beyond FY 2010. The current estimates also include additional production work due to STS-134, which was added to the manifest to launch and install the Alpha Magnetic Spectrometer.	Production of External Tank and Space Shuttle Main Engines is near completion, or completed. NASA will reduce other production contracts, when associated capabilities are no longer needed for safe completion of the Shuttle manifest.
FY 2010 Update: NASA shipped the final Space Shuttle Solid Rocket Motor segments (RSRM 114) to Kennedy Space Center (KSC) in February 2010 and the final Space Shuttle External Tank (ET-138) to KSC in July 2010. The Agency delivered the last External Tank available for flight (ET-122) to KSC in September 2010. The last Space Shuttle Main Engine scheduled for flight (SSME 2061) was delivered to KSC in August 2009. Production contract values declined by 3 percent between FY 2008 and FY 2009, from $1.96 billion to $1.90 billion, and are projected to decline by an additional 22 percent to $1.48 billion in FY 2010. Residual contract value will be maintained through the end of the program to support sustaining engineering activities associated with mission execution.			
International Space Station			
9ISS4 (Outcome 2.1)			
Provide increased ISS capability by assembling the remaining two Japanese Exploration Agency (JAXA) elements, the Exposed Facility (EF) and the Experiment Logistics Module-Exposed Section (ELM-ES), and the NASA EXPRESS Logistics Carriers (ELC) as baselined in FY 2009.	Yellow	NASA launched and assembled the elements of the Exposed Facility and the Experiment Logistics Module, except for the ELCs.	NASA plans to launch and install the ELCs in early FY 2010.
FY 2010 Update: This performance improvement plan was not met due to delays in the Space Shuttle launch schedule caused by the late delivery of the Alpha Magnetic Spectrometer (AMS) payload. NASA launched two of four planned hardware deliveries to the ISS in FY 2010. The last two pieces of hardware, along with the Permanent Multipurpose Module (PMM) and AMS, will be launched in FY 2011.			
Space and Flight Support			
9SFS3 (Outcome 3F.4)			
Capture 100% of medical and environmental data required by Medical Operations in queriable form.	Yellow	Capturing the relevant data is an information technology-based task. The resources necessary to accomplish this task were diverted to work on the Homeland Security Presidential Directive 12 requirement for common identification standards across the Federal government. The action only impacts the timeframe for completion.	CHSP plans to continue with the original set of activities, but with a five-month slip in schedule. The completion date will be the second quarter of FY 2010 rather than the fourth quarter of FY 2009.
FY 2010 Update: Crew Health and Safety met its targeted completion by the second quarter of FY 2010 and captured all relevant data as originally planned.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9SFS4 (Outcome 4.1)			
Coordinate rocket propulsion test activities to support Constellation rocket propulsion testing milestones by providing an agency level Rocket Propulsion Test Plan.	Yellow	Changes to the Constellation Program's schedule and the resulting changes in the respective test programs delayed development of the Rocket Propulsion Test Plan.	At this time enough information exists to create an appropriate plan. Areas where there are still decisions to be made or revisited will be incorporated in the initial plan or revised in yearly updates. A team lead by a NASA Senior Executive will have a final plan by August 2010, and management for the Space Operations Mission Directorate will review and approve the plan by the end of FY 2010.
FY 2010 Update: The Rocket Propulsion Test (RPT) Master Plan is on track for delivery by December 2010, following a carefully constructed 11 month milestone schedule including plan development, a Gap Analysis, and a 90-Day study to assess Chemical Propulsion Information Analysis Center (CPIAC) Database Enhancements, and a U.S. Test Stand Capabilities Analysis. Each of these milestones were completed in August 2010. Currently, report formulation is in work with Center reviews scheduled for the November 2010 timeframe. The RPT Program keeps Space Operation Mission Directorate (SOMD) apprised of the plan's progress through the SOMD Directorate Program Management Council (DPMC).			
9SFS7 (Outcome 6.4)			
Re-compete the Space Network, Near Earth Network and NISN operations and maintenance contracts to provide uninterrupted support of those networks.	Yellow	NASA did select a contractor for the operations and maintenance contract. However, two protests were filed against NASA's decision, which delayed the contract award. NASA extended the current contract to avoid an interruption in support.	The protests are currently under review. SCaN has plans in place to implement this goal once the protests are adjudicated and an award can be made. Network Services continue uninterrupted, but the long-term impact is under assessment due to personnel attrition created by contract uncertainty.
FY 2010 Update: The protest has not yet been resolved and an award has not been made; however, Network Services continue uninterrupted. NASA management is assessing the potential long-term impact of this delay, including the effect on personnel attrition created by contract uncertainty.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
Education			
Education			
9ED3 (Outcome ED-1)			
Engage 8,500 underrepresented and underserved students in NASA higher education programs.	Red	In FY 2008, 6,776 higher education students self-reported being part of an underserved and underrepresented audience (based on race or ethnicity). This represents 28 percent of the number of higher education students served by NASA in FY 2008. Of all higher education students, 41 percent self-reported being women. (Note: data reported is from FY 2008 due to the grant reporting cycle.) The reduction in direct student support reflects an increased Congressional emphasis on research, achieved through institutional (not individual student) awards. The overall reduction in direct support to higher education students affects the total number of higher education underserved and underrepresented students reached by the Office of Education. In FY 2007, the total number of higher education students reached was 34,493; in FY 2008, it dropped to 24,362. Higher education projects have shifted operations to address this new direction, but there is significant lag time before results are available (e.g., new course development time, time to execute activities, grant reporting lag time). Additionally, budgets for higher education projects are effectively flat-lined, but per participant costs for grants are increasing. To offer competitive awards to individuals, NASA grantees (e.g., Space Grant) must increase award sizes that meet cost increases in tuition, travel, and other expenses. In a flat budget environment, an increase in award size means that fewer direct support awards can be made.	All higher education projects are actively working to increase engagement of underrepresented and underserved students. For example, Space Grant program management is successfully encouraging state consortia to increase efforts to engage underrepresented students and to better include more minority-serving institutions in their organizations. In FY 2007, 15 percent of all students reached by Space Grant self-reported being of an underrepresented race or ethnicity. This percentage rose to 21 percent in FY 2008. Future efforts include work with community colleges, an environment with large numbers of underserved audiences.
FY 2010 Update: All higher education projects are actively working to increase engagement of underrepresented and underserved students. Future efforts include work with community colleges, an environment with large numbers of underserved audiences. For example, Space Grant program management is successfully encouraging state consortia to increase efforts to engage underrepresented students and to better include minority-serving institutions in their networks. The strategy has been successful, as participation of racially and ethnically underserved and underrepresented students in Space Grant has increased from 15 percent in FY 2007, to 21 percent in FY 2008, and 29 percent in FY 2009.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9ED14 (Efficiency Measure)			
Reduce the cost per K-12 program participant over FY 2007 amounts by 1%.	Red	Research in science, technology, engineering, and mathematics (STEM) education shows that projects and activities that provide hands-on experiences, intensive internships, and sustained educator professional development relationships are more effective in positively affecting STEM teaching and learning. NASA's Office of Education (OE) has strategically adjusted its elementary and secondary portfolio to include greater investments in these types of experiences, which are more costly, but more effective that short-term, broad-based activities like one-time workshops, auditorium-style presentations and school visits, etc. Elementary and secondary education programming is changing direction within a flat-line (or decreasing core program budget) and this goal is no longer feasible.	OE is pursuing increased investment in activities with higher per participant costs. A balanced OE education portfolio still includes projects and activities with lower costs per participant and reaches large numbers of students and educators. Averaging these different types of investments in one efficiency measure is not practical. OE plans to work with their OMB analyst to revise the performance measure to more accurately reflect new OE strategies and Administration emphasis on high-impact (high cost per participant) investments.
FY 2010 Update: The Office of Education has a number of elementary and secondary projects that respond to education research showing that positive impacts in STEM teaching and learning are achieved through high-touch/high cost per participant types of investments. This strategy to increase the desired impact of education investments is contrary to the APG for reducing costs. The Office of Education plans to work with their OMB analyst to develop a more appropriate efficiency goal.			
Cross-Agency Support Systems			
Advanced Business Systems (Agency IT Services)			
9IEM5 (Outcome IEM-2)			
Achieve cost savings, expected to increase annually with a 2009 goal of $19.3M, resulting from the integration of financial and asset management systems, a reduction in the number of redundant property, plant and equipment (PP&E) systems and process improvements that enable NASA to better manage PP&E assets.	Red	NASA implemented the PP&E System in May 2008 resulting in a cost savings during FY 2009 of $14.7 million, which is 76 percent of the goal as currently stated. However, further evaluation early in the Implementation Phase while providing a business case update resulted in the cost savings for the project being reduced. The initial benefit cost savings for reutilization of assets and loss reduction was overstated substantially based on the recent year's data. However, the NASA FY 2009 Performance Plan measure had already been submitted prior to this revision in cost savings.	The APG was unrealistic and will not be achieved as currently stated.
FY 2010 Update: No Performance Improvement Plan is provided, as there is no possible follow up action needed. The metric was not achieved, because the metric was not realistic and far overstated, based upon final FY 2009 cost benefit analysis.			

Description	Rating	Why the Measure Was Not Met	Plans for Achieving the Measure in FY 2009
9IEM9 (Efficiency Measure)			
Reduce the number of financial processing steps/time to perform year end closing from the 2005 baseline of 120 steps to the 2008 goal of 20 steps (an 83% reduction).	Red	The focus of the measure collection, as written, is on the number of processing steps required to support yearend close. The FY 2008 year-end closing required 98 steps and a system run time of 59 hours (three days). However, a more accurate measure of efficiency improvements achieved is the amount of time that the system is not available to the end users. The system unavailability was reduced from 60-system hours/four and one-half days. The reduction in time relates to system unavailability for processing and that is what is important to the end users. Although the number of steps was not reduced as planned with the upgrade to SAP version ECC 6.0, there was significant reduction in the amount of time that SAP was unavailable to end users during the close process. The upgrade to ECC 6.0 reduced runtime of closing programs from 60 hours to 51 hours, and allowed analyst to perform concurrent years processing, entering FY 2008 data within days of closing the last period in FY 2007.	The reduction in number steps is not an accurate measure of efficiency achieved. The more important measure is the amount of system downtime reduced, which impacts the end users. Therefore, a more appropriate APG has been incorporated into the FY 2010 Performance Plan, to accurately measure the improvements. APG 10IT12 states, "In 2010, reduce the amount of system execution time during the year-end close process by six hours." Based on improved performance of additional hardware, preliminary FY 2009 system executive hours are on target for the six hour reduction noted in FY 2010 Performance Plan measure.
FY 2010 Update: The Process Improvement Plan was translated into a new APG (AGP 10IT12), which stated: "In 2010, reduce the amount of systems execution time during the year-end close process by six hours." This measure is included in this 2010 report, wherein the Agency reduced the year-end process time from 59.0 hours/three days to the current 50.5 hours of lost process time while the year-end process was being closed-out.			

Credit: NASA/ J. Pfaller

At Launch Complex 41 on Cape Canaveral Air Force Station, NASA's Solar Dynamics Observatory, or SDO, enclosed in the Atlas V payload fairing, is lifted from its transporter up the side of the Vertical Integration Facility. The fairing will be placed on top of the rest of the Atlas V rocket, the brown column visible inside the facility. SDO launched a couple of weeks later, on February 11, 2010.

Financials

Message from the Chief Financial Officer

November 15, 2010

The Office of the Chief Financial Officer takes seriously its responsibility for stewardship of the resources entrusted to it and for reporting on the Agency's budget and performance outcomes. This Financials section is the culmination of our efforts to present the Agency's financial status and provide transparency and accountability to the American people. It provides a comprehensive view of the Agency's financial activities undertaken to advance NASA's exploration, space operations, science, aeronautics research, and education missions. It also represents a snapshot of the financial picture resulting from the work performed on a daily basis by NASA finance and budget personnel as we operate across ten centers and multiple locations in the United States and around the world.

I am pleased to report that NASA has made significant progress in financial management during the past year. The independent audit results of the Agency's fiscal year (FY) 2010 financial statements are clear evidence of that progress. The Agency's independent auditors report that, in their opinion, NASA's FY 2010 financial statements present fairly, in all materials respects, the financial position of the Agency as of September 30, 2010, and its budgetary resources for the year then ended, except for the effects of certain FY 2009 adjustments, if any, on the consolidated net cost of operations and consolidated changes in net position.

While the auditor's Report on Internal Control makes it clear that there is room for improvement in controls over Property, Plant, and Equipment (PP&E) records maintained by contractors and continued improvement over the recognition of environmental remediation costs, the progress NASA has made to-date has resulted in the Agency producing financial statements that are auditable and fairly presented, with noted exceptions, for the first time since FY 2002.

This significant accomplishment could only have been achieved through the coordinated efforts of dedicated, hard-working financial and non-financial professionals across the Agency. Most notably, NASA has resolved a long-standing prior year material weakness related to legacy PP&E. Additionally, as a result of successful efforts to integrate property information with the financial accounting system, NASA is now substantially compliant with the Federal Financial Management Improvement Act (FFMIA) for the first time since FY 2000.

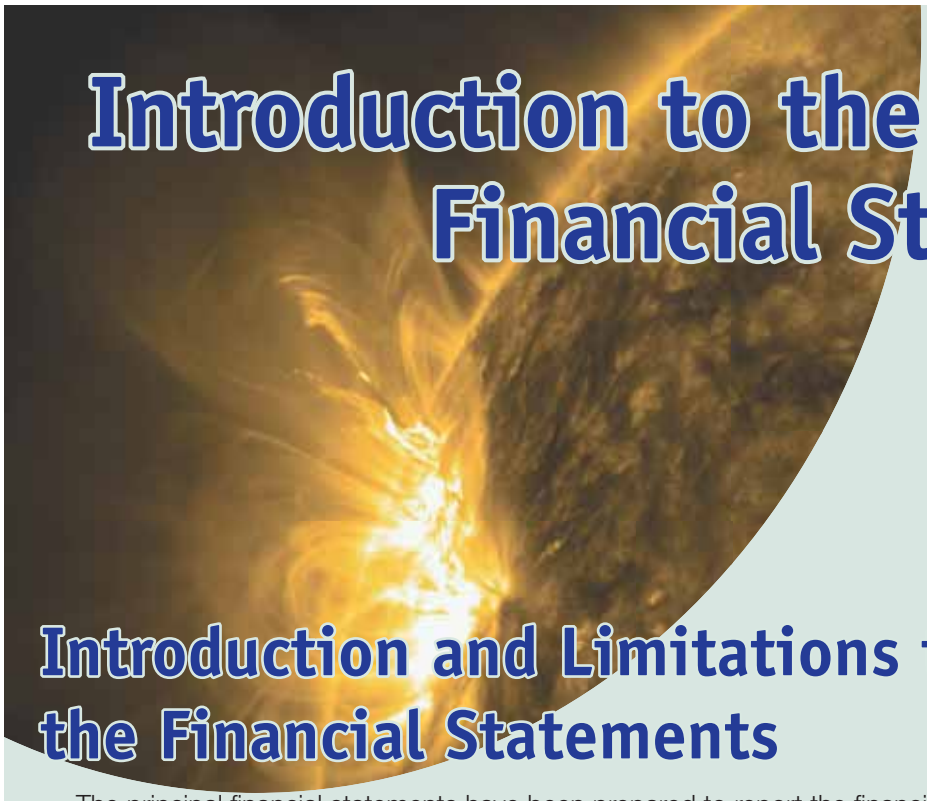
In addition to being recognized for its improvements in financial reporting, the Agency has also made continued, measurable and recognized progress toward providing information to the American taxpayer about its programs and performance, recently through the government-wide Open Government initiative. NASA's Open Government Plan received the highest rating of any agency by both the Office of Management and Budget (OMB) and by the

independent group, *OpenTheGovernment.org*. NASA is among a select group of agencies recognized with "The Leading Practices Awards" for achievement above and beyond the requirements of the Open Government directive. NASA is committed to further improving the transparency around how NASA operates and performs, and in support of that commitment we have recently launched the Open Government Status Dashboard to provide the public with the status of individual milestones and goals set forth in our Plan in an easy-to-read format.

Also worthy of note is NASA's successful administration of efforts supported by the American Recovery and Reinvestment Act (Recovery Act). NASA received $1,050 million of Recovery Act funding in fiscal year 2009, all of which has been obligated on projects to support the Nation's economic recovery and advance NASA's research mission. The Agency received an additional $4 million in Recovery Act Reimbursable Authority in FY 2010. NASA has fully complied with the Recovery Act, as well as ensuing guidelines from the Office of Management and Budget.

We are pleased with our progress and achievements, and we are committed to addressing the deficiencies noted in the audit report. I appreciate the on-going support of the entire Agency, including our mission programs, mission support offices, and Office of Inspector General, as we continue to work together to achieve financial management excellence.

Dr. Elizabeth Robinson
Chief Financial Officer



Introduction to the Principal Financial Statements

Introduction and Limitations to the Financial Statements

The principal financial statements have been prepared to report the financial position and results of operations of the National Aeronautics and Space Administration (NASA), pursuant to the requirements of 31 U.S.C. 3515 (b). While the Statements have been prepared from the books and records of NASA in accordance with Generally Accepted Accounting Principles (GAAP) and the formats prescribed by the Office of Management and Budget (OMB) in Circular No. A-136, Financial Reporting Requirements, the statements are in addition to financial reports prepared by NASA in accordance with OMB and U.S. Department of the Treasury (Treasury) directives to monitor and control the status and use of budgetary resources, which are prepared from the same books and records. The statements should be read with the understanding that they are for a component of the U.S. Government, a sovereign entity. NASA has no authority to pay liabilities not covered by budgetary resources. Liquidation of such liabilities requires enactment of an appropriation. Comparative data for 2009 is included where available. The financial statements, which describe the results of NASA's operations and financial position, are the responsibility of NASA's management. NASA's Principal Financial Statements include the following:

The Consolidated Balance Sheet provides information on assets, liabilities, and net position as of the end of the year, similar to balance sheets reported in the private sector. Assets must equal the sum of liabilities and net position.

The Consolidated Statement of Net Cost reports the components of the net costs of NASA's operations for the period. The net cost of operations consists of the gross cost incurred by NASA less any exchange (i.e., earned) revenue from activities.

The Consolidated Statement of Changes in Net Position reports the beginning net position, the transactions that affect net position for the period, and the ending net position.

The Combined Statement of Budgetary Resources provides information on how budgetary resources were made available and their status for the period. Information in this statement is reported on the budgetary basis of accounting.

Required Supplementary Stewardship Information provides information on NASA's Research and Development and Other Initiatives and Other Initiatives costs.

Required Supplementary Information contains a Combining Statement of Budgetary Resources and information on Deferred Maintenance.

Financial Statements, Notes, and Supplemental Information

National Aeronautics and Space Administration
Consolidated Balance Sheet
As of September 30, 2010 and 2009
(In Millions of Dollars)

	Audited 2010	Unaudited 2009
Assets (Note 2):		
Intragovernmental:		
Fund Balance with Treasury (Note 3)	$ 8,601	$ 8,854
Investments (Note 4)	18	17
Accounts Receivable (Note 5)	69	216
Total Intragovernmental	8,688	9,087
Accounts Receivable, Net (Note 5)	2	2
Inventory and Related Property, Net (Note 6)	--	3,019
Property, Plant and Equipment, Net (Note 7)	9,635	11,577
Other Assets (Note 9)	3	--
Total Assets	**$ 18,328**	**$ 23,685**
Stewardship PP&E (Note 8)		
Liabilities (Note 10):		
Intragovernmental:		
Accounts Payable	$ 136	$ 130
Other Liabilities (Note 12)	108	153
Total Intragovernmental	244	283
Accounts Payable	1,326	1,254
Federal Employee and Veteran Benefits	55	57
Environmental and Disposal Liabilities (Note 11)	1,041	922
Other Liabilities (Note 12)	1,647	1,633
Total Liabilities	**4,313**	**4,149**
Commitments and Contingencies (Note 13)		
Net Position:		
Unexpended Appropriations	5,706	6,128
Cumulative Results of Operations	8,309	13,408
Total Net Position	**14,015**	**19,536**
Total Liabilities and Net Position	$ **18,328**	**$ 23,685**

The accompanying notes are an integral part of this statement.

National Aeronautics and Space Administration
Consolidated Statement of Net Cost
For the Fiscal Years Ended September 30, 2010 and 2009
(In Millions of Dollars)

	Audited 2010	Unaudited 2009
Cost by Research and Development Initiative and Other Initiatives (Note 14):		
Aeronautics Research		
Gross Costs	$ 816	$ 828
Less: Earned Revenue	119	113
Net Costs	697	715
Exploration Systems		
Gross Costs	$ 5,360	$ 5,153
Less: Earned Revenue	62	33
Net Costs	5,298	5,120
Science		
Gross Costs	$ 6,697	$ 6,606
Less: Earned Revenue	649	616
Net Costs	6,048	5,990
Space Operations		
Gross Costs	$ 9,694	$ 11,070
Less: Earned Revenue	429	428
Net Costs	9,265	10,642
Net Cost of Operations		
Total Gross Costs	$ 22,567	$ 23,657
Less: Total Earned Revenue	1,259	1,190
Net Cost	**$ 21,308**	**$ 22,467**

The accompanying notes are an integral part of this statement.

National Aeronautics and Space Administration
Consolidated Statement of Changes in Net Position
For the Fiscal Years Ended September 30, 2010 and 2009
(In Millions of Dollars)

	Audited 2010	Unaudited 2009
Cumulative Results of Operations:		
Beginning Balances	$ 13,408	$ 16,659
Adjustments:		
Change in Accounting Principle (Note 6)	(3,019)	--
Beginning Balances, as adjusted	10,389	16,659
Budgetary Financing Sources:		
Appropriations Used	19,053	18,996
Nonexhange Revenue	9	8
Other Financing Sources:		
Donations and Forfeitures of Property	12	10
Transfers In/Out Without Reimbursement	(2)	57
Imputed Financing	164	151
Other	(8)	(6)
Total Financing Sources	19,228	19,216
Net Cost of Operations	(21,308)	(22,467)
Net Change	(2,080)	(3,251)
Cumulative Results of Operations	**8,309**	**13,408**
Unexpended Appropriations:		
Beginning Balance	6,128	6,389
Budgetary Financing Sources:		
Appropriations Received	18,724	18,784
Other Adjustments	(93)	(49)
Appropriations Used	(19,053)	(18,996)
Total Budgetary Financing Sources	(422)	(261)
Unexpended Appropriations	**5,706**	**6,128**
Net Position	**$ 14,015**	**$ 19,536**

The accompanying notes are an integral part of this statement.

National Aeronautics and Space Administration
Combined Statement of Budgetary Resources
For the Fiscal Years Ended September 30, 2010 and 2009
(In Millions of Dollars)

	Audited 2010	Restated Unaudited 2009
Budgetary Resources:		
Unobligated Balance, Brought Forward, October 1:	$ 1,320	$ 994
Recoveries of Prior Year Unpaid Obligations	330	328
Budgetary Authority		
Appropriation	18,725	18,786
Spending Authority from Offsetting Collections:		
Earned		
Collected	1,475	1,109
Changed in Receivables from Federal Sources	(147)	141
Change in Unfilled Customer Orders		
Advance Received	(87)	27
Without Advance from Federal Sources	(14)	165
Subtotal	19,952	20,228
Permanently Not Available		
Cancellations of Expired and No-year Accounts	(93)	(49)
Total Budgetary Resources	**$ 21,509**	**$ 21,501**
Status of Budgetary Resources:		
Obligations Incurred (Note 15):		
Direct	$ 19,413	$ 18,706
Reimbursable	1,481	1,475
Subtotal	20,894	20,181
Unobligated Balance:		
Apportioned	459	1,130
Unobligated Balance Not Available	156	190
Total Status of Budgetary Resources	**$ 21,509**	**$ 21,501**

The accompanying notes are an integral part of this statement.

National Aeronautics and Space Administration
Combined Statement of Budgetary Resources
For the Fiscal Years Ended September 30, 2010 and 2009
(In Millions of Dollars)

	Audited 2010	Restated Unaudited 2009
Change in Obligated Balance:		
Obligated Balances, Net		
Unpaid Obligations Brought Forward, October 1	$ 8,516	$ 8,975
Less: Uncollected Customer Payments from Federal Sources, Brought Forward, October 1	983	676
Total Unpaid Obligated Balances, Net	7,533	8,299
Obligations Incurred	20,894	20,181
Less: Gross Outlays	20,301	20,313
Less: Recoveries of Prior Year Unpaid Obligations, Actual	330	328
Change in Uncollected Customer Payments from Federal Sources	161	(306)
	$ 7,957	$ 7,533
Obligated Balance, Net, End of Period		
Unpaid Obligations	$ 8,779	$ 8,516
Less: Uncollected Customer Payments from Federal Sources	822	983
Total, Unpaid Obligated Balance, Net, End of Period	**$ 7,957**	**$ 7,533**
Net Outlays:		
Net Outlays		
Gross Outlays	$ 20,301	$ 20,313
Less: Offsetting Collections	1,388	1,136
Less: Distributed Offsetting Receipts	8	8
Net Outlays	**$ 18,905**	**$ 19,169**

The accompanying notes are an integral part of this statement.

NOTE 1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Reporting Entity

The National Aeronautics and Space Administration (NASA) is an independent Agency established by Congress on October 1, 1958 by the National Aeronautics and Space Act of 1958. NASA was incorporated from the Agency's predecessor organization, the National Advisory Committee for Aeronautics, which provided technical advice to the United States (U.S.) aviation industry and performed aeronautics research. Today, NASA serves as the fulcrum for initiatives by the United States in civil space and aviation.

NASA is organized into four Research and Development and Other Initiatives (R&D/Other) which focus on the following objectives:

- Aeronautics Research: conducting research which will significantly enhance aircraft performance, environmental compatibility, and safety, and will enhance the capacity, flexibility, and safety of the future air transportation system;
- Exploration Systems: creating new capabilities, supporting technologies and foundational research for affordable, sustainable human and robotic exploration;
- Science: exploring the Earth, Moon, Mars, and beyond; charting the best route of discovery, and reaping the benefits of Earth and space exploration for society; and
- Space Operations: providing critical enabling technologies for much of the rest of NASA through the Space Shuttle, the International Space Station, and flight support.

NASA's structure includes a Strategic Management Council, a Mission Support Council, and a Program Management Council to integrate NASA's strategic, tactical and operational decisions, and a number of other committees supporting NASA's focus and direction. The organizational structure is designed to position NASA to implement the Vision for Space Exploration.

The nine NASA Centers, NASA Headquarters, and the Jet Propulsion Laboratory carry out the activities of NASA. The Jet Propulsion Laboratory is a federally funded Research and Development center owned by NASA but managed by an independent contractor.

The accompanying financial statements of NASA include the accounts of all funds which have been established and maintained to account for the resources under the control of NASA management.

Basis of Accounting and Presentation

These consolidated financial statements are prepared in accordance with generally accepted accounting principles (GAAP) in the United States of America and standards as promulgated by the Federal Accounting Standards Advisory Board (FASAB) and the Office of Management and Budget (OMB) Circular No. A-136, Financial Reporting Requirements, Revised (September 2010). FASAB is recognized by the American Institute of Certified Public Accountants (AICPA) as the official accounting standards-setting body for United States government entities. The statements present the financial position, net cost of operations, changes in net position, and budgetary resources of NASA, as required by the Chief Financial Officers Act of 1990, Public Law (P.L.) 101-576, and the Government Management Reform Act (P.L. 101-356).

The financial statements should be read with the realization they are a component of the U.S. government, a sovereign entity. One implication of this is that liabilities cannot be liquidated without legislation providing resources and legal authority to do so. The accounting structure of Federal agencies is designed to reflect both accrual and budgetary accounting transactions. Under the accrual method of accounting, revenues are recognized when earned and expenses are recognized when a liability is incurred, without regard to receipt or payment of cash. Budgetary accounting facilitates compliance with legal constraints and controls over the use of Federal funds.

National Aeronautics and Space Administration
Notes to Financial Statements
Fiscal Years 2010 (audited) and 2009 (unaudited)

NOTE 1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

Budgets and Budgetary Accounting

NASA follows standard Federal budgetary accounting policies and practices in accordance with OMB Circular No. A-11, Preparation Submission and Execution of the Budget. To accomplish the goals of NASA's R&D/other initiatives Congress funds NASA through eight main appropriations: Science, Aeronautics, Exploration, Space Operations, Education, Cross-NASA Support, Inspector General, and Construction and Environmental Compliance and Remediation. In 2009, NASA also received funding under the American Recovery and Reinvestment Act of 2009 through five appropriations: Science Recovery Act, Aeronautics Recovery Act, Exploration Recovery Act, Cross-Agency Support Recovery Act and Inspector General Recovery Act. Reimbursements to NASA are used to fund agreements between NASA and other Federal entities or the Public. As part of its reimbursable program, NASA launches devices into space and provides tracking and data relay services for the U.S. Department of Defense and the Department of Commerce (National Oceanic and Atmospheric Administration).

Research and Development, Other Initiatives and Similar Costs

NASA makes substantial R&D investments for the benefit of the United States. NASA's R&D programs include activities to extend our knowledge of Earth, its space environment, and the universe; and to invest in new aeronautics and advanced space transportation technologies supporting the development and application of technologies critical to the economic, scientific, and technical competitiveness of the United States. Accordingly, NASA applies the Financial Accounting Standards Board's (FASB) Accounting Standards Codification (ASC) 730-10-25, Research and Development - Recognition, and FASB ASC 730-10-50 Research and Development - Disclosure, to its R&D projects.

Use of Estimates

The preparation of financial statements requires management to make estimates and assumptions affecting the reported amounts of assets and liabilities as of the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. Actual results could differ from these estimates.

NASA requires major contractors to provide an estimate of their anticipated billing prior to their sending the actual invoice. In addition, NASA requires the contractors to provide an estimate for the next month's anticipated work. When NASA receives these estimates they are compared to the contract under which the work is performed. If the estimate exceeds a specified funding line item, the program manager and the procurement official, as necessary, review the estimate prior to posting in the general ledger as an estimated liability. If the review is not completed within the timeframe for quarterly or yearly reporting, NASA uses the estimates of activity through the current period to establish an estimated liability. However, in this instance NASA fully recognizes that "no agency has the authority to pay liabilities not covered by budgetary resources." Liability to the contractor is not established by receipt of these estimates, but only when accepted by NASA.

Fund Balance with Treasury

Fund Balance with Treasury (FBWT) represents NASA's funds held on deposit with the U.S. Treasury that are available to pay liabilities. NASA's FBWT balance is comprised in general funds, trust funds, and other types of funds.

NOTE 1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

Investments in U.S. Government Securities

Investments include the following Intragovernmental non-marketable securities:

(1) National Aeronautics and Space Administration Endeavor Teacher Fellowship Trust Fund established from public donations in tribute to the crew of the Space Shuttle Challenger

(2) Science, Space and Technology Education (Challenger) Trust Fund established for programs to improve science and technology education

The Endeavor Trust Fund balance is invested in short-term bills, while the Challenger Trust Fund balance is invested in short-term bills and long-term bonds. P.L. 100-404 requires that a quarterly payment of $250,000 is sent to the Challenger Center from interest earned on the Challenger investments. In order to meet the requirement of providing funds to the Challenger Center, NASA invests the bi-annual interest earned in short-term bills that mature in order to provide $250,000 at the end of every quarter. Any interest received and not needed for the quarterly payment to the Challenger Center is invested in a bond maturing on February 15, 2019.

P.L. 102-195 requires the interest earned from the Endeavor investments be used to create the Endeavor Teacher Fellowship Program; however, there have been no funds obligated for this purpose to date.

Accounts Receivable

The majority of NASA's receivables are for intra-governmental reimbursements of R&D costs related to satellites and launch services. A small portion of NASA accounts receivable are debts to NASA by non-Federal government entities. Allowances for doubtful non-Federal accounts are based on factors such as, aging of accounts receivable, debtors' ability to pay, payment history, and other relevant factors. Also, doubtful non-Federal debts over 180 days are referred to the Treasury Department for collection or cross-servicing. Under the cross-servicing program, Treasury can withhold payments due from Treasury to a non-Federal debtor to the extent of debt owed to the Federal government.

Inventory and Related Property

NASA does not maintain inventory stock for resale. NASA follows the purchases method of accounting for operating materials and supplies. The consumption method is not cost beneficial and does not provide the best presentation of NASA's R&D operations. The purchases method provides that operating materials and supplies be expensed when purchased. Prior to FY 2010, amounts displayed as operating materials and supplies were accounted for under the consumption method. In FY 2010, NASA adopted a change in accounting principle and implemented the purchases method of accounting. See Note 6.

Property, Plant and Equipment

NASA reports depreciation expense using the straight-line method, beginning with the month the asset is placed into service. Property with a unit cost of $100,000 or more, a useful life of 2 years or more, and an alternative future use is capitalized. Capitalized costs include costs incurred by NASA to bring the property to a form and location suitable for its intended use. Under provisions of the Federal Acquisition Regulation (FAR), contractors are responsible for control and accountability for Government-owned property in their possession.

NASA has barter agreements with international entities including the European Space Agency and the National Space Agency of Japan, related largely to the International Space Station. The intergovernmental agreements state that the parties will seek to minimize the exchange of funds in the cooperative program, including the use of barters to provide goods and services. As of September 30, 2010, NASA has received some assets from these parties in exchange for future services. The fair value is indeterminable; therefore, no value was ascribed to these transactions in accordance with FASB ASC 845-10-25 Non-Monetary Transactions – Recognition and ASC 845-10-50 Non-Monetary Transactions –Disclosure. The amounts reflected in NASA's financial reports for the ISS exclude components of the ISS owned or provided by other participants in the ISS.

NOTE 1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

Property, Plant and Equipment (continued)

In FY 2010, NASA adopted Statement of Federal Financial Accounting Standards (SFFAS) No. 35, Estimating the Historical Cost of General Property, Plant and Equipment (PP&E). Accordingly, in those circumstances when original historical cost information is not readily available, NASA uses reasonable estimates of original historical cost to value PP&E balances. SFFAS No. 35 was applied to the International Space Station and Real Property assets in service as of FY 2010, none of which required adjustments to recorded balances.

Capitalized costs for internally developed software include the full costs (direct and indirect) incurred during the software development stage only. For purchased software, capitalized costs include amounts paid to vendors for the software and material internal costs incurred by NASA to implement and make the software ready for use through acceptance testing. When NASA purchases software as part of a package of products and services (for example: training, maintenance, data conversion, reengineering, site licenses, and rights to future upgrades and enhancements), capitalized and non-capitalized costs of the package are allocated among individual elements on the basis of a reasonable estimate of their relative fair market values. Costs not susceptible to allocation between maintenance and relatively minor enhancements are expensed.

NASA capitalizes costs for internal use software when the total projected cost is $1 million or more and the expected useful life of the software is 5 years or more.

Liabilities Covered by Budgetary Resources

Liabilities covered by budgetary resources are liabilities covered by realized budgetary resources as of the balance sheet date. Realized budgetary resources include new budget authority, unobligated balances of budgetary resources at the beginning of the year, and spending authority from offsetting collections. Examples include accounts payable and salaries.

Liabilities and Contingencies Not Covered by Budgetary Resources

Generally liabilities not covered by budgetary resources are liabilities for which congressional action is needed before budgetary resources can be provided. Liabilities not covered by budgetary resources include certain environmental matters, legal claims, pensions and other retirement benefits, workers' compensation, annual leave, and closed appropriations.

Federal Employee and Veterans' Benefits

A liability was recorded for workers' compensation claims related to the Federal Employees' Compensation Act (FECA), administered by the U.S. Department of Labor. The FECA provides income and medical cost protection to covered Federal civilian employees injured on the job, employees who have incurred a work-related occupational disease, and beneficiaries of employees whose death is attributable to a job-related injury or occupational disease. The FECA program initially pays valid claims and subsequently seeks reimbursement from the Federal agencies employing the claimants.

The FECA liability includes the actuarial liability for estimated future costs of death benefits, workers' compensation, and medical and miscellaneous costs for approved compensation cases. This liability is reported on the Federal Employee and Veteran Benefits line on the balance sheet. The present value of these estimates at year-end was calculated by the Department of Labor using a discount rate of 3.65% in FY 2010 and 4.22% in FY 2009. This liability includes the estimated future costs for claims incurred but not reported or approved as of the end of each year.

NOTE 1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

Personnel Compensation and Benefits

Annual Sick and Other Leave

Annual leave is accrued as it is earned; the accrual is reduced as leave is taken. Each year, the balance in the accrued annual leave account is adjusted to reflect current pay rates. To the extent current or prior year appropriations are not available to fund annual leave earned but not taken, funding will be obtained from future financing sources. Sick leave and other types of non-vested leave are expensed as taken.

Retirement Benefits

NASA employees participate in the Civil Service Retirement System (CSRS), a defined benefit plan, or the Federal Employees Retirement System (FERS), a defined benefit and contribution plan. For CSRS employees, NASA makes contributions of 7.0 percent of pay. For FERS employees, NASA makes contributions of 11.2 percent to the defined benefit plan, contributes 1 percent of pay to a retirement saving plan (contribution plan), and matches employee contributions up to an additional 4 percent of pay. For FERS employees, NASA also contributes to employer's matching share for Social Security taxes.

Insurance Benefits

The FASAB's SFFAS No. 5, Accounting for Liabilities of the Federal Government, requires Government agencies to report the full cost of Federal Employee Health Benefits (FEHB), and the Federal Employees Group Life Insurance (FEGLI) Programs. NASA uses the applicable cost factors and imputed financing sources provided by the Office of Personnel and Management to value these liabilities.

Other

Certain FY 2009 amounts have been restated due to subsequent OMB guidance on the reporting of offsetting receipts.

NOTE 2. NON-ENTITY ASSETS

The majority of NASA's assets are considered entity assets. The balance of non-entity assets was not significant at September 30, 2010 and 2009.

NOTE 3. FUND BALANCE WITH TREASURY

Fund Balance with Treasury (FBWT) represents the aggregate amount of the NASA's funds held on deposit with the U.S. Treasury that are available to pay liabilities. NASA's FBWT balance is comprised in general funds, trust funds, and other types of funds. General Funds primarily consists of appropriated funds for NASA. Trust Funds include balances in Endeavor Teacher Fellowship; National Space Grant Program; Science, Space and Technology Education; and Gifts and Donations. Other Fund types include Working Capital Fund; Fines, Penalties, and Forfeitures; General Fund Proprietary Interest; Collections of Receivables from Canceled Appropriations; General Fund Proprietary Receipts; Budget Clearing and Suspense; Unavailable Check Cancellation; Undistributed Intragovernmental Payment; State and Local Taxes; Other Payroll; and U.S. Employee Allotment Account, Savings Bonds.

(In Millions of Dollars)	2010	2009
Fund Balances:		
General Funds	$ 8,533	$ 8,801
Trust Funds	3	4
Other Fund Types	65	49
Total	**$ 8,601**	**$ 8,854**

The status of Fund Balance with Treasury is the total fund balance as recorded in the general ledger for unobligated and obligated balances. Unobligated Balances - Available is the amount remaining in appropriation accounts available for obligation in future fiscal years. Unobligated Balances - Unavailable is the amount remaining in appropriation accounts used only for adjustments to previously recorded obligations. Obligated Balances - Not Yet Disbursed is the cumulative amount of obligations incurred for which outlays have not been made. Non-budgetary FBWT is comprised of amounts in other fund types.

(In Millions of Dollars)	2010	2009
Status of Fund Balances with Treasury:		
Unobligated Balances		
Available	$ 459	$ 1,130
Unavailable	156	190
Obligated Balance Not Yet Distributed	7,957	7,533
Non- Budgetary FBWT	29	1
Total	**$ 8,601**	**$ 8,854**

NOTE 4. INVESTMENTS

NASA's investments consist of non-marketable par value intragovernmental securities issued by Treasury's Bureau of the Public Debt. The trust fund balances are invested in Treasury securities, which are purchased at either a premium or discount, and redeemed at par value exclusively through Treasury's Federal Investment Branch. The effective-interest method was utilized to amortize premiums on bonds, and the straight-line method was utilized to amortize discounts on bills.

NASA has Interest Receivable just below the displayable threshold of a million dollars. In addition, NASA did not have any adjustments resulting from the sale of securities prior to maturity or any change in value that is more than temporary.

2010

(In Millions of Dollars)	Cost	Amoritization Method	Amoritzed (Premium) Discount	Interest Receivable	Investments, Net	Other Adjustments	Market Value Disclo-sure
Intragovernmental Securities:		Straight-Line					
Non- Marketable:		Effective-interest					
Par value	$19	0.155 - 6.602%	$ (1)	$ --	$ 18	$ --	$ 18
Total	**$19**		**$ (1)**	**$ --**	**$ 18**	**$ --**	**$ 18**

2009

(In Millions of Dollars)	Cost	Amoritization Method	Amoritzed (Premium) Discount	Interest Receivable	Investments, Net	Other Adjustments	Market Value Disclo-sure
Intragovernmental Securities:		Straight-Line					
Non-Marketable:		Effective-interest					
Par value	$18	0.185 - 6.602%	$ (1)	$ --	$ 17	$ --	$ 17
Total	**$18**		**$ (1)**	**$ --**	**$ 17**	**$ --**	**$ 17**

NOTE 5. ACCOUNTS RECEIVABLE, NET

The Accounts Receivable balance represents net valid claims by NASA to cash or other assets of another entity. Intragovernmental Accounts Receivable represents reimbursements due from other Federal entities for goods and services provided by NASA on a reimbursable basis. Accounts Receivable Due from the Public is the total of miscellaneous debts due to NASA from employees and/or smaller reimbursements from other non-Federal entities. A periodic evaluation of public accounts receivable is performed to estimate any uncollectible amounts based on current status, financial and other relevant characteristics of debtors, and the overall relationship with the debtor. An allowance for doubtful accounts is recorded, for Accounts Receivable Due from the Public, in order to bring Accounts Receivable to its Net Realizable Value in accordance with SFFAS No. 1, Accounting for Selected Assets and Liabilities. The total allowance for doubtful accounts during both FY 2009 and FY 2010 was less than $500 thousand.

	2010		
(In Millions of Dollars)	Accounts Receivable	Allowance for Uncollectible Accounts	Net Amount Due
Intragovernmental	$ 69	$ --	$ 69
Public	2	--	2
Total	**$ 71**	**$ --**	**$ 71**

	2009		
(In Millions of Dollars)	Accounts Receivable	Allowance for Uncollectible Accounts	Net Amount Due
Intragovernmental	$ 216	$ --	$ 216
Public	2	--	2
Total	**$ 218**	**$ --**	**$ 218**

NOTE 6. INVENTORY AND RELATED PROPERTY, NET

The decrease in Inventory and Related Property is due to a change in accounting principle in FY 2010. In FY2009 and prior, NASA accounted for Operating Materials and Supplies (OM&S) using the consumption method. In FY 2010, NASA reviewed the consumption method in relation to its business processes and operations and determined that it did not reflect NASA's business processes and operations and that the purchases method explained in SFFAS No. 3, Accounting for Inventory and Related Property, is the preferred method.

SFFAS No. 21, Reporting Corrections of Errors and Changes in Accounting Principles, states that the cumulative effect of the change on prior periods should be reported as a change in accounting principle. Accordingly, NASA adjusted the beginning balance of the cumulative results of operations in the Statement of Changes in Net Position by $3,019 million.

(In Millions of Dollars)	2010	2009
Operating Materials and Supplies		
Items Held for Use	$ --	$ 3,016
Items Held in Reserve for Future Use	--	3
Total	**$ --**	**$ 3,019**

NOTE 7. PROPERTY, PLANT, AND EQUIPMENT, NET (PP&E)

Property, plant and equipment is depreciated using the straight-line method, beginning with the month the asset is placed into service. Property with a unit cost of $100,000 or more and a useful life of 2 years or more and an alternative future use is capitalized. Capitalized costs include costs incurred to bring the property to a form and location suitable for its intended use. Under provisions of the Federal Acquisition Regulation (FAR), contractors are responsible for control and accountability of Government-owned property in their possession.

NASA began depreciating the International Space Station in Fiscal Year (FY) 2001 when manned by the first permanent crew. Only the Station's major elements in space, which represents US owned hardware components that are delivered and installed on-orbit, are depreciated; any on-ground elements are reported as Assets Under Construction (AUC) until launched and incorporated into the existing Station structure.

In FY 2010, NASA adopted SFFAS No. 35, Estimating the Historical Cost of General Property, Plant and Equipment (PP&E). Accordingly, in those instances when original historical cost information is not readily available, NASA uses reasonable estimates of original transaction data historical cost to value PP&E balances.

Certain items in FY 2009 have been reclassified from Space Shuttle to Institutional Equipment for comparability purposes as these items support multiple NASA projects.

NOTE 7. PROPERTY, PLANT, AND EQUIPMENT, NET (PP&E) (CONTINUED)

2010

(In Millions of Dollars)	Depreciation Method	Useful Life	Cost	Accumulated Depreciation	Book Value
Space Exploration PP&E					
International Space Station	Straight-line	5 - 20 years	$ 12,584	$ (6,312)	$ 6,272
Space Shuttle	Straight-line	5 - 20 years	8,468	(8,468)	--
Assets Under Construction		N/A	316	--	316
Work-in-Process- Equipment		N/A	--	--	--
Total			**21,368**	**(14,780)**	**6,588**
General PP&E					
Land			123	--	123
Structures, Facilities and Leasehold Improvements	Straight-line	15 - 40 years	8,044	(6,165)	1,879
Institutional Equipment	Straight-line	5 - 20 years	1,312	(1,040)	272
Construction in Process		N/A	715	--	715
Internal Use Software and Development	Straight-line	5 years	223	(165)	58
Total			**10,417**	**(7,370)**	**3,047**
Total Property, Plant, and Equipment			**$ 31,785**	**$ (22,150)**	**$ 9,635**

Restated 2009

(In Millions of Dollars)	Depreciated Method	Useful Life	Cost	Accumulated Depreciation	Book Value
Space Exploration PP&E					
International Space Station	Straight-line	5 - 20 years	$ 11,456	$ (5,758)	$ 5,698
Space Shuttle	Straight-line	5- 20 years	8,889	(8,379)	510
Assets Under Construction		N/A	1,303	--	1,303
Work-in-Process - Equipment		N/A	1,180	--	1,180
Total			**22,828**	**(14,137)**	**8,691**
General PP&E					
Land			122	--	122
Structures, Facilities and Leasehold Improvements	Straight-line	15 - 40 years	7,790	(5,942)	1,848
Institutional Equipment	Straight-line	5 - 20 years	1,425	(1,093)	332
Construction in Process		N/A	506	--	506
Internal Use Software and Development	Straight-line	5 years	219	(141)	78
Total			10,062	(7,176)	2,886
Total Property, Plant, and Equipment			**$ 32,890**	**$ (21,313)**	**$ 11,577**

NOTE 8. STEWARDSHIP PP&E

Federal agencies are required to classify and report heritage assets in accordance with SFFAS No. 29, Heritage Assets and Stewardship Land.

Stewardship PP&E have physical characteristics similar to those of general PP&E (G-PP&E) but differ from G-PP&E because their value is more intrinsic and not easily determinable in dollars. The only type of stewardship PP&E owned by NASA are Heritage Assets.

Heritage Assets are PP&E which possess one or more of the following characteristics:

- Historical or natural significance;
- Cultural, educational, or aesthetic value, or
- Significant architectural characteristics.

Dollar value and useful life of heritage assets are not easily determinable. There is no minimum dollar threshold for designating a PP&E as heritage asset, and depreciation expense is not taken on these assets.

NASA's heritage assets include buildings and structures designated as National Historic Landmarks, as well as air and spacecraft and related components on display to enhance public understanding of NASA programs. The most important attribute of heritage assets is their existence. NASA reports these assets in physical units, as follows.

	2009	Additions	Withdrawals	2010
Buildings and Structures	12	5	1	16
Air and Space Displays and Artifacts	523	20	18	525
Art and Miscellaneous Items	1,014	6	1	1,019
Total Heritage Assets	**1,549**	**31**	**20**	**1,560**

	2008	Additions	Withdrawals	2009
Buildings and Structures	18	--	6	12
Air and Space Displays and Artifacts	521	8	6	523
Art and Miscellaneous Items	1,015	--	1	1,014
Total Heritage Assets	**1,554**	**8**	**13**	**1,549**

When a G-PP&E is designated as heritage asset, its cost and accumulated depreciation are removed from the books. Heritage assets are generally in fair condition suitable for display. They remain on the record as heritage assets, except where there is legal authority for transfer or sale. However, they are withdrawn when they become inactive or reclassified as multi-use heritage assets.

For more than 30 years, the NASA Art Program has documented America's major accomplishments in aeronautics and space. During that time, artists have generously contributed their time and talent to record their impressions of the U.S. Aerospace Program in paintings, drawings, and other media. Not only do these art works provide a historic record of NASA projects, they give the public a new and fuller understanding of advancements in aerospace. Artists give a special view of NASA through the back door. Some have witnessed astronauts in training or scientists at work. The art collection, as a whole, depicts a wide range of subjects, from Space Shuttle launches to aeronautics research, Hubble Space Telescope, and even virtual reality.

NOTE 8. STEWARDSHIP PP&E (CONTINUED)

Artists commissioned by NASA receive a small honorarium in exchange for donating a minimum of one piece to the NASA archive. In addition, more works have been donated to the National Air and Space Museum.

In accordance with SFFAS No. 29, the cost of acquisition, improvement, reconstruction, or renovation of heritage assets is expensed in the period incurred.

In accordance with SFFAS No. 29, heritage assets that are used in day-to-day government operations are considered "multi-use" heritage assets that are not used for heritage purposes. Such assets are accounted for as general property, plant, and equipment and are capitalized and depreciated in the same manner as other general property, plant, and equipment. For FY 2010, NASA had 89 buildings, structures, and equipment that are considered to be multi-use heritage assets. The values of these assets are included in the property, plant, and equipment values shown in the Financial Statements.

NOTE 9. OTHER ASSETS

The Other Assets balance represents general PP&E assets that NASA determines are no longer needed and are awaiting disposal, retirement, or removal from services. These amounts are recorded at estimated net realizable value

(In Millions of Dollars)	2010	2009
Other		
Pending Disposal	$ 3	$ --
Total	**$ 3**	**$ --**

NOTE 10. LIABILITIES NOT COVERED BY BUDGETARY RESOURCES

Liabilities not covered by budgetary resources are liabilities for which congressional action is needed before budgetary resources can be provided. They include certain environmental matters (Note 11, Environmental and Disposal Liabilities), legal claims, pensions and other retirement benefits, workers' compensation, annual leave, and closed appropriations.

NASA has recorded Accounts Payable related to closed appropriations for which there are contractual commitments to pay. These payables will be funded from appropriations available for obligation at the time a bill is processed, in accordance with P.L. 101-510, National Defense Authorization Act.

(In Millions of Dollars)	2010	2009
Intragovernment Liabilities:		
Other Liabilities		
Workers' Compensation	$ 13	$ 14
Accounts Payable for Closed Appropriations	3	8
Total Intragovernmental	16	22
Public Liabilities:		
Accounts Payable		
Accounts Payable for Closed Appropriations	35	34
Federal Employee and Veterans Benefits		
Actuarial FECA Liability	55	57
Environmental and Disposal Liabilities	1,041	922
Other Liabilities		
Unfunded Annual Leave	213	208
Total Liabilities Not Covered by Budgetary Resources	**1,360**	**1,243**
Total Liabilities Covered by Budgetary Resources	**2,953**	**2,906**
Total Liabilities	**$ 4,313**	**$ 4,149**

NOTE 11. ENVIRONMENTAL AND DISPOSAL LIABILITIES

(In Millions of Dollars)	2010	2009
Probable		
Known Hazardous Conditions	$ 893	$ 812
Anticipated Cleanup at Disposal: Space Shuttle	132	110
Anticipated Cleanup at Disposal: Other PP&E	16	--
Total	**$ 1,041**	**$ 922**
Reasonably Possible		
Known Hazardous Conditions	$ 116	$ 17
Anticipated Cleanup at Disposal: Space Shuttle	46	54
Anticipated Cleanup at Disposal: Other PP&E	--	7 - 19
Total	**$ 162**	**$ 78 - 90**

Environmental and Disposal Liabilities represents cleanup costs resulting from:

- Operations that include facilities obtained from other governmental entities that have resulted in contamination from waste disposal methods, leaks and spills;
- Other past activity that created a public health or environmental risk, or
- Total cleanup costs associated with the removal, containment, and/or disposal of hazardous wastes or material and/or property that have been deferred until operation of associated property, plant, and equipment (PP&E) ceases either permanently or temporarily.

Federal, State, and local statutes and regulations require environmental cleanup. Some of these statutes include: the Comprehensive Environmental Response, Compensation, and Liability Act; the Resource Conservation and Recovery Act; the Nuclear Waste Policy Act of 1982; as well as State and local laws.

NASA assesses the likelihood of required cleanup as probable, reasonably possible or remote. If the likelihood of required cleanup is probable and the cost can be reasonably estimated, a liability is recorded in the financial statements. If the likelihood of required cleanup is reasonably possible, the estimated cost of cleanup is disclosed in the notes to the financial statements. If the likelihood of required cleanup is remote, no liability is recorded or estimate disclosed.

If site-specific engineering estimates for cleanup are not available, NASA employs parametric modeling software to estimate the total cost of cleaning up known contamination at these sites for current and future years. The estimates calculated by the parametric models may be classified as probable or reasonably possible.

Consistent with SFFAS No. 6, Accounting for Property, Plant, and Equipment, NASA estimates the anticipated environmental disposal cleanup costs for current and planned capital PP&E. NASA recognizes and records in its financial statements an environmental cleanup liability for those in-service PP&E with a probable and measurable environmental cleanup liability of $100,000 or more.

Probable Environmental and Disposal Liabilities

In FY 2010, NASA recorded an additional $119 million dollars of environmental and disposal liabilities to reflect the estimated total cost of environmental cleanup on known hazardous conditions bringing the total to $1,041 million which includes anticipated cleanup at disposal for Space Shuttle and PP&E. The amount recorded in FY 2009 was $922 million. The increase is due to changes in individual project estimates and additional liabilities from disposal-related cleanup costs for PP&E. During FY 2010, NASA engaged an independent consultant to inventory all PP&E of permitted facilities through FY 2009, in accordance with its stated policy. This report was the primary basis for the Other PP&E decommissioning and clean up cost reported above.

NOTE 11. ENVIRONMENTAL AND DISPOSAL LIABILITIES (CONTINUED)

The estimate for unfunded environmental liabilities could change in the future due to identification of additional contamination, inflation, deflation, a change in technology or applicable laws and regulations as well as through ordinary liquidation of these liabilities as the cleanup program continues into the future. Estimates change primarily due to updated information being available on the extent of contamination and remediation efforts that would be required.

Reasonably Possible Environmental and Disposal Liabilities

In addition to the probable cleanup costs for known hazardous conditions recognized in the financial statements, there are other potential remediation sites where the likelihood of required cleanup for known hazardous conditions is reasonably possible. FY 2010 remediation costs at certain sites classified as reasonably possible were estimated to be $162 million dollars. In FY 2009, these remediation costs were estimated between $78 million and $90 million.

The costs necessary to cleanup Space Shuttle equipment for museum display are expected to be the responsibility of the institution displaying the equipment. If NASA is required to incur those costs, NASA estimated $46 million of Space Shuttle disposal costs (for the periods FY 2013 through FY 2016) as reasonably possible. Consistent with NASA's approach described above, this reasonably possible estimate is not recorded but is disclosed in the financial statements.

With respect to environmental remediation that NASA believes is reasonably possible but not estimable, NASA believes that either the likelihood of NASA liability is less than probable but more than remote or the regulatory drivers and/or technical data that exist are not reliable enough to calculate an estimate.

The ISS is designed and planned to be de-orbited over the Pacific Ocean. The ISS will be destroyed during reentry. Accordingly, no end-of-life environmental liability is anticipated for the ISS.

As noted in footnote 7, NASA maintains numerous structures and facilities, some of which are known to contain asbestos. Current technical guidelines do not require the recording of a contingent liability resulting from future asbestos remediation efforts. Management is developing estimates of the cost to remediate asbestos contamination which does not pose an immediate health hazard either because it is friable but not exposed, or non-friable consistent with applicable FASAB guidance which calls for recognition of such asbestos, if determinable, in FY 2012. Management does not believe such amounts will be material.

NOTE 12. OTHER LIABILITIES

NASA contracts with vendors for various types of goods and services that are necessary to accomplish its mission. The period of performance for these contracts typically spans the duration of NASA programs, which could be numerous years. The vendor performs tasks in accordance with the contract instructions and specifications throughout this period, prior to final delivery and NASA's acceptance of the product. In such cases, NASA records a cost accrual as the work is performed and constructive acceptance of the end product occurs throughout the fiscal year. The contractor provides cost reports or estimates, which is the basis to record an accrual for contractor costs.

			2010
(In Millions of Dollars)	**Current**	**Non Current**	**Total**
Intragovernmental Liabilities:			
Advances From Others	$ 64	$ --	$ 64
Worker's Compensation	5	8	13
Employer Contributions and Payroll Taxes	25	--	25
Liability for Deposit and Clearing Funds	--	--	--
Other Accrued Liability	6	--	6
Total Intragovernmental	**100**	**8**	**108**
Unfunded Annual Leave	--	213	213
Accrued Funded Payroll	115	--	115
Advances from Others	35	--	35
Employer Contributions and Payroll Taxes	4	--	4
Liability for Deposit Funds	28	--	28
Other Accrued Liabilities	1,252	--	1,252
Total from the Public	**1,434**	**213**	**1,647**
Total Other Liabilities	**$ 1,534**	**$ 221**	**$ 1,755**

			2009
(In Millions of Dollars)	**Current**	**Non-Current**	**Total**
Intragovernmental Liabilities:			
Advances From Others	$ 110	$ --	$ 110
Workers' Compensation	5	9	14
Employer Contributions and Payroll Taxes	22	--	22
Liability for Deposit and Clearing Funds	1	--	1
Other Accrued Liability	6	--	6
Total Intragovernmental	**144**	**9**	**153**
Unfunded Annual Leave	--	208	208
Accrued Funded Payroll	106	--	106
Advances from Others	57	--	57
Employer Contributions and Payroll Taxes	4	--	4
Other Accrued Liabilities	1,258	--	1,258
Total from the Public	**1,425**	**208**	**1,633**
Total Other Liabilities	**$ 1,569**	**$ 217**	**$ 1,786**

NOTE 13. CONTINGENT LIABILITIES

NASA is a party in various administrative proceedings, court actions (including tort suits), and claims. For cases management and legal counsel believe it is probable that the outcomes will result in a loss to NASA, liabilities are recorded. For September 30, 2010 and September 30, 2009, the amount of liability recorded was less than $1 million. There were certain cases reviewed by legal counsel where the probable future loss is remote and as such no liability has been recorded in connection with these cases.

NASA is concluding the Constellation and Shuttle programs. As a result, certain contracts in support of these programs are nearing completion. It is possible that additional liabilities and costs may result, including those from employee benefit plans. In addition, certain other contracts may contain provisions regarding contingency obligations to fund accumulated unfunded employee benefit and other contract termination costs upon contract termination.

NOTE 14. INTRAGOVERNMENTAL COST AND EXCHANGE REVENUE

Intragovernmental costs and revenue are exchange transactions made between NASA and other federal government entities. Costs and revenue with the Public result from transactions between NASA and other non-federal entities.

(In Millions of Dollars)	2010	2009
Aeronautics Research		
Intragovernmental Costs	$ 46	$ 43
Public Cost	770	785
Total Aeronautics Research Costs	816	828
Less:		
Intragovernmental Earned Revenue	103	94
Public Earned Revenue	16	19
Total Aeronautics Research Earned Revenue	119	113
Total Aeronautics Research Net Cost	**$ 697**	**$ 715**
Exploration Systems		
Intragovernmental Costs	$ 250	$ 228
Public Cost	5,110	4,925
Total Exploration Systems Costs	5,360	5,153
Less:		
Intragovernmental Earned Revenue	45	19
Public Earned Revenue	17	14
Total Exploration Systems Earned Revenue	62	33
Total Exploration Systems Net Cost	**$ 5,298**	**$ 5,120**
Science		
Intragovernmental Costs	$ 411	$ 395
Public Cost	6,286	6,211
Total Science Costs	6,697	6,606
Less:		
Intragovernmental Earned Revenue	623	595
Public Earned Revenue	26	21
Total Science Earned Revenue	649	616
Total Science Net Cost	**$ 6,048**	**$ 5,990**
Space Operations		
Intragovernmental Costs	$ 404	$ 471
Public Cost	9,290	10,599
Total Space Operations Costs	9,694	11,070
Less:		
Intragovernmental Earned Revenue	369	349
Public Earned Revenue	60	79
Total Space Operations Earned Revenue	429	428
Total Space Operations Earned Net Cost	**$ 9,265**	**$ 10,642**
Net Cost of Operations	**$ 21,308**	**$ 22,467**

NOTE 15. APPORTIONMENT CATEGORIES OF OBLIGATIONS INCURRED: DIRECT VS. REIMBURSABLE OBLIGATIONS

Category A consists of amounts requested to be apportioned for each calendar quarter in the fiscal year. Category B consists of amounts requested to be apportioned on a basis other than calendar quarters, such as time periods other than quarters, activities, projects, objects, or a combination thereof.

((In Millions of Dollars)	2010	2009
Direct Obligations:		
Category A	$ 1	$ 1
Category B	19,412	18,705
Reimbursable Obligations:		
Category B	1,481	1,475
Total Obligations Incurred	**$ 20,894**	**$ 20,181**

NOTE 16. EXPLANATION OF DIFFERENCES BETWEEN THE STATEMENT OF BUDGETARY RESOURCES (SBR) AND THE BUDGET OF THE U.S. GOVERNMENT

The FY 2012 Budget of the United States Government (President's Budget) presenting the actual amounts for the year ended September 30, 2010 has not been published as of the issue date of these financial statements. The FY 2012 President's Budget is scheduled for publication in 2011.

NASA reconciled the amounts of the FY 2009 column on the Statement of Budgetary Resources (SBR) to the actual amounts for FY 2009 in the FY 2011 President's Budget for budgetary resources, obligations incurred, distributed offsetting receipts and net outlays as presented below.

(In Millions of Dollars)	Budgetary Resources	Obligations	Distributed Offsetting Receipts	Net Outlays
Combined Statement of Budgetary Resources	$ 21,501	$ 20,181	$ (8)	$ 19,177
Included on SBR, not in the President's Budget				
Expired Accounts	(206)	(16)	--	--
Distributed Offsetting Receipts	--	--	8	--
Other	(3)	1	--	--
Budget of the United States Government	**$ 21,292**	**$ 20,166**	**$ --**	**$ 19,177**

The difference between the Statement of Budgetary Resources and the President's Budget represents expired, unobligated balances reported on the SBR but not in the Budget of the United States Government and other is primarily rounding.

NOTE 17. UNDELIVERED ORDERS AT THE END OF THE PERIOD

Undelivered Orders at the end of the period totaled $5.9 billion and $5.8 billion as of September 30, 2010 and September 30, 2009, respectively.

NOTE 18. RECONCILIATION OF NET COST TO BUDGET

SFFAS No.7, Accounting for Revenues and Other Financing Concepts for Reconciling Budgetary and Financial Accounting, requires a reconciliation of proprietary and budgetary accounting information. Accrual-based measures used in the Statement of Net Cost differ from the obligation-based measures used in the Statement of Budgetary Resources.

The Statement of Financing is intended to provide assurance that certain financial information is consistent with similar amounts found in budget reports. This note reconciles obligations of budget authority to the accrual-based net cost of operations. The Net Cost of Operations as presented on the Statement of Financing is determined by netting the obligations as adjusted and non-budgetary resources and making adjustments for the total resources that do not fund net cost of operations, the total costs that do not require resources, and financing sources yet to be provided. The result is Net Cost of Operations as reported on the Statement of Net Cost.

(In Millions of Dollars)	2010	2009
Resources Used to Finance Activities		
Budgetary Resources Obligated		
Obligation Incurred	$ 20,894	$ 20,181
Less: Spending Authority from Offsetting Collections and Recoveries	1,557	1,770
Obligations Net of Offsetting Collections and Recoveries	19,337	18,411
Less: Offsetting Receipts	--	1
Net Obligations	19,337	18,410
Other Resources		
Donations & Forfeitures of Property	12	10
Transfers In (Out) Without Reimbursements	(2)	57
Imputed Financing from Costs Absorbed by Others	164	151
Net Other Resources Used to Finance Activities	174	218
Total Resources Used to Finance Activities	**19,511**	**18,628**
Resources Used to Finance Items Not Part of the Net Cost of Operations		
Change in Budgetary Resources Obligated for Goods, Services, and Benefits Ordered But Not Yet Provided	(245)	583
Resources that Fund Expenses Recognized in Prior Periods	(29)	(71)
Resources that Finance the Acquisition of Assets	(2,172)	(3,023)
Other Resources or Adjustments to Net Obligated Resources that Do Not Affect Net Cost of Operations	(10)	(67)
Total Resources Used to Finance Items Not Part of the Net Cost of Operations	**(2,456)**	**(2,578)**
Total Resources Used to Finance the Net Cost of Operations	**$ 17,055**	**$ 16,050**

NOTE 18. RECONCILIATION OF NET COST TO BUDGET (CONTINUED)

(In Millions of Dollars)	2010	2009
Components of Net Cost that Will Not Require of Generate Resources in the Current Period		
Components Requiring or Generating Resources in Future Periods		
Increases in Annual Leave Liability	$ 5	$ 12
Increases in Environmental and Disposal Liability	119	--
Other	10	--
Total Components of Net Cost that Will Require or Generate Resources in Future Periods	134	12
Components Not Requiring or Generating Resources		
Depreciation	1,444	2,511
Revaluation of Assets or Liabilities	10	(62)
Other	2,665	3,956
Total Components of Net Cost of Operations that Will Not Require or Generate Resources	4,119	6,405
Total Components of Net Cost of Operations that Will Not Require or Generate Resources in the Current Period	**4,253**	**6,417**
Net Cost of Operations	**$ 21,308**	**$ 22,467**

NOTE 19. OTHER INFORMATION

In FY 2010, NASA reviewed its PP&E balances to determine if SFFAS No. 35 should be applied to those balances. Those reviews resulted in the standard being applied to the ISS and Real Property (Structures, Facilities, and Leasehold Improvements) balances only. No adjustments were recorded because the alternative support for these balances indicated that the recorded values were materially correct. In addition, NASA did review its Institutional Equipment to determine if application of SFFAS No. 35 was necessary, but determined that the recorded balances were adequately supported by documentation consistent with SFFAS No. 6 requirements.

National Aeronautics and Space Administration
Required Supplementary Stewardship Information
Fiscal Years 2010, 2009, 2008, 2007 and 2006
Stewardship Investments: Research and Development and Other Initiatives

NASA's programs and activities are carried out through four R&D/Other initiatives: Aeronautics Research, Exploration Systems, Science and Space Operations. Each initiative is comprised of multiple themes and numerous programs comprise each theme. In FY 2006 NASA's former enterprise structure was mapped to the new R&D structure and NASA reports expenses using this new structure. Therefore, R&D expenses are now reported on a program, not Enterprise basis. This is NASA's fifth year reporting under this new structure.

To provide the reader with a full picture of NASA expenses, both R&D and non-R&D, NASA has included expenses for non R&D costs associated with NASA activities such as Education and Outreach, Space Operations Programs. Descriptions for the work associated with these costs are also presented.

Research and Development and Other Initiative Costs by Theme and Program

(In Millions of Dollars)	2010	2009	2008	2007	2006
Aeronautics Research					
Aeronautics Technology					
Aviation Safety	$ 78	$ 79	$ 81	$ 74	$ 63
Airspace Systems	103	124	108	84	34
Fundamental Aeronautics	272	337	367	350	283
Aeronautics Test	67	70	66	38	--
Integrated Systems Research	26	--	--	--	--
Aeronautics Technology Total	546	610	622	546	380
Aeronautics Research Total	**$ 546**	**$ 610**	**$ 622**	**$ 546**	**$ 380**
Exploration Systems					
Constellation Systems					
Constellation Systems	$ 3,381	$ 3,150	$ 3,092	$ 1,731	$ 241
Commercial Crew and Cargo	98	122	--	--	--
Constellation Systems Total	3,479	3,272	3,092	1,731	241
Advanced Capabilities					
Human Research Program	156	157	80	--	--
Exploration Technology Development	275	314	280	124	--
Lunar Precursor Robotic Program	44	94	124	147	37
Advanced Capabilities Total	475	565	484	271	37
Exploration Other R & D Costs	15	30	224	623	882
Exploration Systems Total	**$ 3,969**	**$ 3,867**	**$ 3,800**	**$ 2,625**	**1,160**

National Aeronautics and Space Administration
Required Supplementary Stewardship Information
Fiscal Years 2010, 2009, 2008, 2007 and 2006
Stewardship Investments: Research and Development and Other Initiatives

Research and Development and Other Initiative Costs by Theme and Program (continued)

(In Millions of Dollars)	2010	2009	2008	2007	2006
Science					
Earth Science					
Earth Science Research	$ 427	$ 423	$ 522	$ 596	$ 289
Earth Systematic Missions	780	807	777	473	204
Earth System Science Pathfinder	97	99	121	117	63
Earth Science Multi-Mission Operations	155	138	165	192	127
Earth Science Technology	51	58	76	142	431
Applied Sciences	45	47	45	37	6
Earth Science Total	1,555	1,572	1,706	1,557	1,120
Planetary Science					
Planetary Science Research	234	240	264	207	191
Lunar Quest Program	43	--	--	--	--
Discovery	219	230	201	258	270
New Frontiers	278	296	102	115	197
Mars Exploration	376	408	772	687	353
Outer Planets	97	64	--	--	--
Technology	87	85	55	91	188
Planetary Science Total	1,334	1,323	1,394	1,358	1,199
Astrophysics					
Astrophysics Research	155	183	278	310	463
Cosmic Origins	630	584	--	--	--
Physics of the Cosmos	131	87	--	--	--
Exoplanet Exploration	63	27	--	--	--
Astrophysics Explorer	110	118	85	68	29
Astrophysics Total	1,089	999	363	378	492
Heliophysics					
Heliophysics Research	174	158	77	--	--
Living with a Star	255	179	149	143	89
Solar Terrestrial Probes	109	89	60	46	42
Heliophysics Explorer	55	37	55	72	62
New Millennium	4	8	3	--	--
Near Earth Networks	1	8	48	--	--
Deep Space Mission Systems (DSMS)	4	71	229	221	181
Heliophysics Total	602	550	621	482	374
Science Historical R & D Costs	17	215	878	809	1,156
Science Total	**$ 4,597**	**$ 4,659**	**$ 4,962**	**$ 4,584**	**$ 4,341**
Total Research & Development Expenses	**$ 9,112**	**$ 9,136**	**$ 9,384**	**$ 7,755**	**$ 5,881**

National Aeronautics and Space Administration
Required Supplementary Stewardship Information
Fiscal Years 2010, 2009, 2008, 2007 and 2006
Stewardship Investments: Research and Development and Other Initiatives

Non-Research and Development and Other Initiative Costs by Theme and Program

(In Millions of Dollars)	2010	2009	2008	2007	2006
Aeronautics Research					
Aeronautics Indirect Cost	$ 270	$ 218	$ 157	$ 154	$ 749
Aeronautics Research Tool	**$ 270**	**$ 218**	**$ 157**	**$ 154**	**$ 749**
Exploration Systems					
Exploration Systems Indirect Cost	$ 1,391	$ 1,286	$ 1,011	$ 592	$ 1,542
Exploration Systems Total	**$ 1,391**	**$ 1,286**	**$ 1,011**	**$ 592**	**$ 1,542**
Science					
Earth Science					
Education and Outreach	$ 3	$ 14	$ 17	$ 9	$ 5
Science Indirect Costs	2,097	1,933	1,413	913	2,279
Science Total	**$ 2,100**	**$ 1,947**	**$ 1,430**	**$ 922**	**$ 2,284**
Space Operations					
Space Shuttle					
Space Shuttle	$ 3,190	$ 3,176	$ 3,309	$ 3,338	$ 3,216
Hurricane Repairs	25	102	94	106	54
Subtotal Space Shuttle	3,215	3,278	3,403	3,444	3,270
International Space Station	2,289	2,148	1,588	1,398	1,233
Space and Flight Support (SFS)					
Space Communications and Navigation	590	547	238	138	67
Human Space Flight Operations	81	--	--	--	--
Launch Services	105	201	406	339	335
Rocket Propulsion Test	40	46	45	49	53
Crew Health & Safety	9	9	8	8	6
Subtotal Space and Flight support (SFS)	825	803	697	534	461
Space Operation Indirect Cost	3,365	4,841	1,761	1,067	3,153
Space Operations Total	**$ 9,694**	**$ 11,070**	**$ 7,449**	**$ 6,443**	**$ 8,117**
Total Non-Research & Development Expenses	**$ 13,455**	**$ 14,521**	**$ 10,047**	**$ 8,111**	**$ 12,692**
Total Expenses	**$ 22,567**	**$ 23,657**	**$ 19,431**	**$ 15,866**	**$ 18,573**

STEWARDSHIP INVESTMENTS: Research and Development and Other Initiatives (continued)

NASA makes substantial Research and Development investments for the benefit of the United States. These amounts are expensed as incurred in determining the net cost of operations.

NASA's Research and Development and Other Initiatives programs include activities to extend our knowledge of Earth, its space environment, and the universe, and to invest in new aeronautics and advanced space transportation technologies that support the development and application of technologies critical to the economic, scientific, and technical competitiveness of the United States.

Investment in Research and Development and Other Initiatives refers to those expenses incurred to support the search for new or refined knowledge and ideas and for the application or use of such knowledge and ideas for the development of new or improved products and processes with the expectation of maintaining or increasing national economic productive capacity or yielding other future benefits.

Research and Development and Other Initiatives: Theme and Program Descriptions

AERONAUTICS

Theme: Aeronautics Technology (AT)

Aeronautics Technology develops technologies to improve aircraft and air system safety, security and performance; reduce aircraft noise and emissions; and increase the capacity of the National Airspace System (NAS).

Program: Aviation Safety

The Aviation Safety Program (AvSP) develops innovative tools, concepts, methods, and technologies that will improve the intrinsic safety attributes of current and future aircraft, and that will help overcome aviation safety challenges that would otherwise constrain the full realization of the Next Generation Air Transportation System (NextGen).

Program: Airspace Systems Program

The Airspace Systems Program (ASP) conducts research to enable NextGen capabilities such as foundational research in multi-aircraft flow and airspace optimization, trajectory design and conformance, separation methods, and adaptive systems. The Program research for the airspace and airportal domains is integrated into gate-to-gate solutions.

Program: Fundamental Aeronautics

The Fundamental Aeronautics Program (FAP) conducts research to enable the design of vehicles that fly through any atmosphere at any speed. Future aircraft must address multiple design challenges, and therefore a key focus will be the development of physics-based, multidisciplinary design, analysis, and optimization (MDAO) tools.

National Aeronautics and Space Administration
Required Supplementary Stewardship Information
Fiscal Years 2010, 2009, 2008, 2007 and 2006
Stewardship Investments: Research and Development and Other Initiatives

Program: Aeronautics Test Program

The Aeronautics Test Program (ATP) is dedicated to the mastery and intellectual stewardship of the core competencies of Aeronautics testing, both on the ground and in the air. ATP's purpose is to ensure the strategic availability of a minimum, critical suite of aeronautical test facilities which are necessary to meet the long-term needs and requirements of the nation.

Program: Integrated Systems Research

The Integrated Systems Research Program aims to take a system-level approach to reduce the environmental impact of aviation. The environmental impact of various air vehicle technologies are evaluated in terms of noise, local and global emissions, and local air quality.

EXPLORATION SYSTEMS

Theme: Constellation Systems

Through the Constellation Systems Theme NASA planned to develop, demonstrate, and deploy systems that will enable sustained human and robotic exploration of the Moon, Mars, and beyond.

Program: Constellation Systems

The Constellation Program was intended to create a new generation of spacecraft for human spaceflight, consisting primarily of the Ares I and Ares V launch vehicles, the Orion crew capsule, the Earth Departure Stage, and the Altair Lunar Lander.

Program: Commercial Crew and Cargo

The Commercial Crew and Cargo is a partnership between NASA and industry aimed at spurring private industry to provide cost-effective cargo and crew delivery to the International Space Station and expanding the commercial technology sector. Ultimately, the partnership hopes to allow NASA to focus its internal resources on exploration.

Theme: Advanced Capabilities

The Advanced Capabilities Theme provides knowledge, technology, and innovation that will enable current and future exploration missions.

Program: Human Research

The Human Research program (HRP) investigates and mitigates the highest risks to human health and performance in support of NASA exploration missions. ESMD and Constellation Systems documents provide the mission architecture definitions, mission concepts of operations, vehicle, habitat, and space suit performance requirements, and other technical information needed to focus the HRP efforts for specific exploration missions. HRP conducts research, develops countermeasures, and undertakes technology development to inform and support compliance with NASA's health, medical, human performance, and environmental standards.

Program: Exploration Technology Development

The Exploration Technology Development Program (ETDP) develops new technologies that will enable NASA to conduct future human and robotic exploration missions, while reducing mission risk and cost. By maturing new technologies to the level of demonstration in a relevant environment early enough to support a flight system's Preliminary Design Review, NASA can significantly reduce both cost and risk.

Program: Lunar Precursor Robotic

The Lunar Precursor Robotic program supports America's return to the Moon by executing lunar robotic missions to conduct research and prepare for future human exploration. These missions will gather data important for reducing the risks to astronauts, identify resources, and map the lunar environment.

SCIENCE

Theme: Earth Science

NASA studies this dynamic Earth system to trace effect to cause, connect variability and forcing with response, and vastly improve national capabilities to predict climate, weather, natural hazards, and conditions in the space environment.

Program: Earth Science Research

The Earth Science Research Program improves the capability to document the global distribution of a range of important environmental parameters related to the Earth's atmosphere, hydrosphere, biosphere, cryosphere, and land surface; to understand the processes that drive and connect them; and to improve our capability to predict the future evolution of the Earth system, including climate, weather, and natural hazards.

Program: Earth Systematic Missions

Earth Systematic Missions provide Earth observing satellites that contribute to the provision of long-term environmental data sets that can be used to study the evolution of the Earth system on a range of temporal scales. This information is used to analyze, model, and improve understanding of the Earth system.

Program: Earth System Science Pathfinder

The Earth System Science Pathfinder (ESSP) program addresses unique, specific, highly-focused mission requirements in Earth science research. ESSP includes a series of relatively low to moderate cost, small to medium sized, competitively selected, principal investigator led missions that are built, tested, and launched in a short time interval. These missions are capable of supporting a variety of scientific objectives related to Earth science, involving the atmosphere, oceans, land surface, polar ice regions and solid earth.

Program: Earth Science System Multi-Mission Operations

The Earth Science Multi-Mission Operations Program acquires, preserves, and distributes observational data to support Earth Science focus areas in conformance with national science objectives. Facilities involved in this undertaking include data-handling, data processing, and archiving systems.

Program: Earth Science Technology

The Earth Science Technology Program (ESTP) provides the Earth Science Theme with new capabilities, enabling previously unforeseen or infeasible science investigations, enhancing existing measurement capabilities, and reducing the cost, risk, and development times of Earth science measurements.

National Aeronautics and Space Administration
Required Supplementary Stewardship Information
Fiscal Years 2010, 2009, 2008, 2007 and 2006
Stewardship Investments: Research and Development and Other Initiatives

Program: Applied Sciences

The Applied Sciences Program is focused on working with Federal agencies and national organizations to extend the use of technology and data associated with NASA's constellation of Earth system observing spacecraft. These spacecraft, which routinely make measurements using dozens of research instruments, are used by a community of Earth system scientists in laboratories, universities, and research institutions throughout the country, and around the world, to model the Earth system and improve predictions, projections, and forecasts.

Theme: Planetary Science

The Planetary Science Theme advances scientific knowledge of the origin and history of the solar system, including the history of life and whether it evolved beyond Earth. Equally important is finding resources, evaluating, and mitigating the risks to humans that will be encountered as we conduct an overall balanced program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

Program: Planetary Science Research

The Planetary Science Research program develops the theoretical tools and laboratory data needed to analyze flight data, makes possible new and better instruments to fly on future missions, and analyzes the data returned so that the program can answer specific questions posed and fit this new knowledge into the overall picture of the solar system.

Program: Lunar Quest Program

The Lunar Quest Program (LQP) conducts science exploration of the Moon through research and analysis, as well as through the development of a series of small-medium satellite and surface missions. The goal of LQP is to provide small robotic lunar science investigations and lunar research and analysis addressing prioritized science objectives. The objectives include re-establishing lunar science and a lunar science community, facilitating the application of enhancing or enabling technologies to support flight missions, and enhancing science opportunities in the implementation of NASA's lunar exploration goals.

Program: Discovery

NASA's Discovery program gives scientists the opportunity to find innovative ways to unlock the mysteries of the solar system. It provides lower-cost, highly focused planetary science investigations designed to enhance our understanding of the solar system. The Discovery program offers the scientific community the opportunity to assemble a team and design exciting, focused science investigations that complement NASA's larger planetary science explorations.

Program: New Frontiers

The New Frontiers program, a class of competed medium-sized missions, represents a critical step in the advancement of the solar system exploration. Proposed science targets for the New Frontiers program include Pluto and the Kuiper Belt, Jupiter, Venus, and sample returns from Earth's Moon and a comet nucleus.

Program: Mars Exploration

The Mars Exploration program has been developed to conduct a rigorous, incremental, discovery-driven exploration of Mars to determine the planet's physical, dynamic, and geological characteristics, investigate the Martian climate in the context of understanding habitability, and investigate whether Mars ever had the potential to develop and harbor any kind of life.

Program: Outer Planets

The Outer Planets Program enables science investigations across a broader array of disciplines and in more depth than competed missions. The science discoveries made by these missions are not expected to be easily displaced with time and are expected the overthrow previous paradigms and create new ones in their place.

Program: Technology

Robotic spacecraft use electrical per for propulsion, data acquisition, and communication to accurately place themselves in orbit around and onto the surfaces of bodies about which we may know relatively little. These systems ensure that they survive and function in hostile and unknown environments, acquire and transmit data throughout their lifetimes, and sometimes transport samples back to Earth. Since successful completion of these missions is so dependent on power, the future Planetary Science program portfolio of missions will demand advances in power and propulsion systems.

Theme: Astrophysics

The Astrophysics Theme seeks to understand the cycles of matter and energy that formed, evolve, and govern the universe, and how they created the unique conditions that support life. Where are we from? Are we alone? NASA searches for answers to these questions looking far away, towards the beginning of time, to see galaxies forming, and close to home, in search of planetary systems like Earth around nearby stars.

Program: Astrophysics Research

The Astrophysics Research program (formerly Universe Research) strives to answer critical questions about the nature of the universe with a host of operating missions led by investigators from academia and industry, as well as funding grants for basic research, technology development, and data analysis from past and current missions. All data collected by missions are archived in data centers located at universities and NASA centers throughout the country.

Program: Cosmic Origins

The Cosmic Origins missions explore how the expanding universe grew into a grand, cosmic web of galaxies; how stars and planets formed within the galaxies; how stars created the heavy elements, such as carbon, that are essential for life. Major breakthroughs in our knowledge of the cosmos have already been made with the current suite of missions.

National Aeronautics and Space Administration
Required Supplementary Stewardship Information
Fiscal Years 2010, 2009, 2008, 2007 and 2006
Stewardship Investments: Research and Development and Other Initiatives

Program: Physics of the Cosmos

Reveal laws and forces of the universe at the most fundamental level in ways that can only be done from space. Missions will probe back to the beginning of time by measuring the cosmic microwave background radiation in novel ways and using gravity waves as an entirely new window on the universe. The nature of dark matter that shepherds the growth of galaxies and large-scale structure will be determined, the mysterious dark energy pervading the universe will be uncovered and the limits of Einstein's theories will be tested.

Program: Exoplanet Explorer

The Exoplanet Explorer Program, through the use of astrometry, precision interferometry and eventually direct detection, will embark on a series of missions designed to detect and characterize Earth-sized planets that are orbiting in the "habitable zone" of nearby stars (the range of distances at which the liquid water could be stable at the planet's surface). The goal is to gain insight into one of humans most timeless questions: Are we alone?

Program: Astrophysics Explorer

The Astrophysics Explorer program (formerly Explorer) provides frequent flight opportunities for world-class astrophysics and space physics investigations, utilizing innovative, streamlined and efficient management approaches to spacecraft development and operations. The program (including Future Explorers) is managed within the Earth -Sun Theme, but selected projects are managed under the Universe Theme.

Theme: Heliophysics

The Heliophysics Theme studies the science of the Sun-Solar System Connection to: (1) understand the Sun and its effects on Earth, the solar system, and the space environmental conditions that will be experienced by explorers, and (2) demonstrate technologies that can improve future operational systems.

Program: Heliophysics Research

The Heliophysics Research program undertakes scientific investigations utilizing operational spacebased and suborbital platforms (surface, balloon, aircraft, and rocket). The program also funds basic research and modeling utilizing the results of the full array of NASA's missions.

Program: Living with a Star

The Living with a Star (LWS) program seeks to understand how and why the Sun varies, how Earth and other planets respond, and how the variability and response affect humanity. Achieving these goals will enable a reliable space weather prediction so undesirable space weather effects can be accommodated or mitigated before they occur.

Program: Solar Terrestrial Probes

The primary goal of the Solar Terrestrial Probes (STP) Program is to understand how the Sun, heliosphere, and planetary environments are connected in a single system.

Program: Heliophysics Explorer

The Heliophysics Explorer program provides frequent flight opportunities for world-class astrophysics and space physics investigations, using innovative, streamlined and efficient management approaches to spacecraft development and operations. The program is composed of an on-going series of space science missions that are independent, but share a common funding and management structure. The program emphasizes missions that can be accomplished under the control of the scientific research community and seeks to control total mission life-cycle costs. It also seeks to enhance public awareness of, and appreciation for, space science and to incorporate educational and public outreach activities.

Program: New Millennium

The New Millennium Program (NMP) is a technology flight validation program designed to retire risk of key emerging and breakthrough technologies to enable future NASA science missions. The objectives are to capitalize on investments being made in U.S. technological capabilities and accelerate the incorporation of payoff, advanced technologies into future science missions by conducting in-space validation missions, when the technologies must be tested in space in order to be validated. NMP allows NASA to conduct technology maturation and validation in low-cost NMP projects, rather than during science mission development.

Program: Near Earth Networks

The Near Earth Networks program provides multi-mission driven space flight tracking, telemetry and command, meteorological and photo-optical services and associated activities of customer interface, network and range scheduling, cross-cutting maintenance and systems engineering, facilities, safety, and security. These services are for near-Earth spaceflight missions, including human space flight (Space Shuttle Program and Constellation), sounding rockets, and near-Earth orbital flight in support of Science missions, Space Operations, Exploration Systems, and aeronautics services for unmanned aerial vehicle, aircraft, and rockets in support of upper atmospheric research.

Program: Deep Space Mission Systems (DSMS)

The Deep Space Mission System (DSMS) program enables human and robotic exploration of the solar system and beyond by providing reliable, high-performance, and cost-effective telecommunications and navigation services.

Non-Research and Development and Other Initiatives Programs

SCIENCE

Theme: Earth Science

Program: Education and Outreach

The Earth Science Education and Outreach Program seeks to make the discoveries and knowledge generated from NASA's Earth-observing satellites and scientific research (including applied science) accessible to students, teachers, and the public. It addresses workforce preparation and the education pipeline, and engages the public in better understanding NASA Earth Science research results from space.

National Aeronautics and Space Administration
Required Supplementary Stewardship Information
Fiscal Years 2010, 2009, 2008, 2007 and 2006
Stewardship Investments: Research and Development and Other Initiatives

SPACE OPERATIONS

Theme: Space Shuttle

The Space Shuttle is currently the only launch capability owned by the United States that enables human access to space, and the only vehicle that can support the assembly of the International Space Station (ISS). NASA will phase-out the Space Shuttle within the next few years when its role in ISS assembly is complete.

Program: Space Shuttle

NASA manifested the last six Space Shuttle mission for FY 2010 and 2011, including the STS-129 mission that flew in November 2009 and the STS-130 mission in February 2010. The final six flight of the Space Shuttle are dedicated to completing assembly of the International Space Station (ISS), delivering and installing the Alpha Magnetic Spectrometer (AMS) to the ISS, and prepositioning equipment so that the ISS can achieve its full research potential. NASA will continue its priority to safety complete the remaining Space Shuttle manifest.

Program: Hurricane Repairs

The Hurricane Repairs include emergency supplemental costs for Hurricane Katrina response and recovery.

Theme: International Space Station

This Theme supports the construction and operations of a research facility in low Earth orbit as NASA's first step in achieving the Vision for Space Exploration. The ISS provides a unique, continuously operating capability to develop medical countermeasures for long-term human space travel: develop and test technologies and engineering solutions in support of exploration; and provide ongoing practical experience in living and working in space. It also supports a variety of pure and applied research for the U.S. and its International Partners. ISS assembly will be completed by the end of the decade. NASA is examining configurations for the Space Station that meet the needs of both the new space exploration vision and our international partners using as few Shuttle flights as possible. A key element of the ISS program is the crew and cargo services project, which will purchase services for cargo and crew transport using existing and emerging capabilities.

Theme: Space and Flight Support

This theme encompasses Space Communications, Launch Services, Rocket Propulsion Testing, and Crew Health and Safety. Space Communications consists of (1) the Tracking and Data Relay Satellite System (TDRSS), which supports activities such as the Space Shuttle, ISS, Expendable Launch Vehicles, and research aircraft, and (2) the NASA Integrated Services Network, which provides telecommunications services at facilities, such as flight support networks, mission control centers and science facilities, and administrative communications networks for NASA Centers. The Launch Services program focuses on meeting the Agency's launch and payload processing requirements by assuring safe and cost-effective access to space via the Space Shuttle and expendable launch vehicles.

Program: Space Communications and Navigations

The Space Communications Program (SCP) links flight missions to Earth to accomplish mission objectives. NASA's backbone of communications capabilities reliably transmits data between the ground control centers and the flight missions. These capabilities keep the missions operating safely and return volumes of science and technology data that has led to innumerable discoveries about Earth, the solar system, and the universe.

Program: Human Space Flight Operations

The Human Space Flight Operations operates the Space Flight Crew Operations which provides trained crew members for all of NASA human space flight endeavors. The program supports up to six human space flights on the Space Shuttle to the International Space Station, as well as long-duration crew on ISS and crew expertise to Constellation development.

Program: Launch Services

The Launch Services Program, which works closely with other government agencies and the launch industry, seeks to ensure that the most safe, reliable, on-time, cost-effective launch opportunities are available on a wide range of launch systems.

Program: Rocket Propulsion Testing

As the principal implementing authority for NASA's rocket propulsion testing, the Rocket Propulsion Test (RPT) Program reviews, approves, and provides direction on rocket propulsion test assignments, capital asset improvements, test facility modernizations and refurbishments, integration for multi-site test activities, identification and protection of core capabilities, and the advancement and development of test technologies.

Program: Crew Health & Safety

The health care of the NASA Astronaut Corps is the responsibility of space medical operations at the Johnson Space Center. A portion of the responsibilities for that care is managed within the Crew Health and Safety program (CHS). CHS enables the following: 1) healthy and productive crew during all phases of spaceflight missions; 2) implementation of a comprehensive health care program for astronauts; and 3) the prevention and mitigation of negative long-term health consequences of space flight.

National Aeronautics and Space Administration
Required Supplementary Information
Combining Schedule of Budgetary Resources
For the Fiscal Year Ended September 30, 2010

(In Millions of Dollars)	Space Operations	Science Mission	Exploration Mission	Aeronautics Mission	Cross-Agency Mission	Education Mission	Office of Inspector General	American Recovery and Reinvestment Act	Construction and Environmental Compliance and Restoration	Other	Total
Budgetary Resources											
Unobligated Balance, Brought Forward, October 1	$91	$62	$47	$4	$291	$28	$2	$608	$ —	$187	$1,320
Recoveries of Prior Year Obligations	63	84	61	7	45	—	—	6	—	64	330
Budget Authority:											
Appropriation	6,147	4,469	3,746	501	3,194	183	36	—	448	1	18,725
Spending Authority from Offsetting Collections											
Earned											
Collected	8	—	—	—	1,226	—	1	33	3	204	1,475
Change in Receivable Federal Sources	(1)	—	—	—	(125)	—	—	(1)	—	(20)	(147)
Change in Unfilled Orders											
Advance Received	(7)	—	—	—	(46)	—	1	1	—	(36)	(87)
Without Advance from Federal Sources	(2)	—	—	—	108	—	1	(29)	—	(91)	(14)
Subtotal	6,145	4,469	3,746	501	4,357	183	38	4	451	58	19,952
Non expenditure Transfers, Net:											
Actual Transfers, Budget Authority	(5)	28	31	(4)	(52)	(2)	—	—	4	—	—
Actual Transfers, Unobligation Balances	1	—	—	—	—	—	—	—	—	(1)	—
Permanently Not Available											
Cancellation of Expired and No-year Accounts	—	—	—	—	—	—	(2)	—	—	(91)	(93)
Total Budgetary Resources	**$6,295**	**$4,643**	**$3,885**	**$508**	**$4,641**	**$209**	**$38**	**$618**	**$455**	**$217**	**$21,509**
Status of Budgetary Resources											
Obligations Incurred:											
Direct:	$6,139	$4,582	$3,740	$474	$3,220	$203	$35	$612	$369	$39	$19,413
Reimbursable:	2	—	—	—	1,398	—	1	4	1	75	1,481
Subtotal	6,141	4,582	3,740	474	4,618	203	36	616	370	114	20,894
Unobligated Balance:											
Apportioned	98	61	145	34	21	6	2	2	77	13	459
Unobligated Balance Not Available	56	—	—	—	2	—	—	—	8	90	156
Total Status of Budgetary Resources	**$6,295**	**$4,643**	**$3,885**	**$508**	**$4,641**	**$209**	**$38**	**$618**	**$455**	**$217**	**$21,509**

	Space Operations	Science Mission	Exploration Mission	Aeronautics Mission	Cross-Agency Mission	Education Mission	Office of Inspector General	American Recovery and Reinvestment Act	Construction and Environmental Compliance and Restoration	Other	Total
Change in Obligated Balance											
Unpaid Obligation Balance, Net, October 1	$1,433	$2,243	$1,108	$210	$880	$118	$6	$356	$ —	$1,179	$7,533
Obligations Incurred	6,141	4,582	3,740	474	4,618	203	36	616	370	114	20,894
Less: Gross Outlays	5,801	4,181	3,530	471	4,428	96	35	677	68	1,014	20,301
Less: Recoveries of Prior Year Unpaid Obligations	63	84	61	7	45	—	—	6	—	64	330
Change in Uncollected Customer Payments from Federal Sources	3	—	—	—	17	—	—	30	—	111	161
	$1,713	$2,560	$1,257	$206	$1,042	$225	$7	$319	$302	$326	$7,957
Obligated Balance, Net, End of Period											
Unpaid Obligations	$1,725	$2,560	$1,257	$206	$1,782	$225	$7	$337	$302	$378	$8,779
Less: Uncollected Customer Payments from Federal Sources	12	—	—	—	$740	—	—	18	—	52	822
Total, Unpaid Obligated Balance, Net, End of Period	**$1,713**	**$2,560**	**$1,257**	**$206**	**$1,042**	**$225**	**$7**	**$319**	**$302**	**$326**	**$7,957**
Outlays											
Net Outlays:											
Gross Outlays	$5,801	$4,181	$3,530	$471	$4,428	$96	$35	$677	$68	$1,014	$20,301
Less: Offsetting Collections	1	—	—	—	1,180	—	2	34	3	168	1,388
Less: Distributed Offsetting Receipts	—	—	—	—	—	—	—	—	—	8	8
Net Outlays	**$5,800**	**$4,181**	**$3,530**	**$471**	**$3,248**	**$96**	**$33**	**$643**	**$65**	**$838**	**$18,905**

National Aeronautics and Space Administration
Required Supplementary Information
Combining Schedule of Budgetary Resources
For the Fiscal Year Ended September 30, 2009 Restated

(In Millions of Dollars)	Space Operations	Science Mission	Exploration Mission	Aeronautics Mission	Cross-Agency Mission	Education Mission	Office of Inspector General	American Recovery and Reinvestment Act	Other	Total
Budgetary Resources										
Unobligated Balance, Brought Forward, October 1	$245	$ —	$ —	$ —	$ —	$ —	$3	$ —	$746	$994
Recoveries of Prior Year Obligations	101	—	—	—	—	—	—	—	227	328
Budget Authority:										
Appropriation	5,765	4,503	3,506	500	3,306	169	34	1,002	1	18,786
Spending Authority from Offsetting Collections										
Earned										
Collected	162	—	—	—	466	—	—	—	481	1,109
Change in Receivable from Federal Sources	(27)	—	—	—	190	—	—	1	(23)	141
Change in Unfilled Orders										
Advance Received	(47)	—	—	—	137	—	—	—	(63)	27
Without Advance from Federal Sources	(96)	—	—	—	567	—	—	46	(352)	165
Subtotal	5,757	4,503	3,506	500	4,666	169	34	1,049	44	20,228
Nonexpenditure Transfers, Net:										
Actual Transfers, Budget Authority	—	—	—	—	—	—	—	—	—	—
Actual Transfers, Unobligation Balances	—	—	—	—	—	—	—	—	—	—
Permanently Not Available										
Cancellations of Expired and No-year Accounts	—	—	—	—	—	—	(1)	—	(48)	(49)
Enacted Reductions	—	—	—	—	—	—	—	—	—	—
Total Budgetary Resources	**$ 6,103**	**$4,503**	**$3,506**	**$500**	**$4,666**	**$169**	**$36**	**$1,049**	**$969**	**$21,501**
Status of Budgetary Resources										
Obligations Incurred:										
Direct:	$5,969	$4,441	$3,459	$496	$3,245	$141	$33	$393	$529	$18,706
Reimbursable:	43	—	—	—	1,130	—	1	48	253	1,475
Subtotal	6,012	4,441	3,459	496	4,375	141	34	441	782	20,181
Unobligated Balance:										
Apportioned	43	62	47	4	291	28	—	608	47	1,130
Subtotal	43	62	47	4	291	28	—	608	47	1,130
Unobligated Balance Not Available	48	—	—	—	—	—	2	—	140	190
Total Status of Budgetary Resources	**$6,103**	**$4,503**	**$3,506**	**$500**	**$4,666**	**$169**	**$36**	**$1,049**	**$969**	**$21,501**

	Space Operations	Science Mission	Exploration Mission	Aeronautics Mission	Cross-Agency Mission	Education Mission	Office of Inspector General	American Recovery and Reinvestment Act	Other	Total
Change in Obligated Balance										
Obligated Balance, Net, October 1	$2,236	$ —	$ —	$ —	$ —	$ —	$3	$ —	$6,060	$8,299
Obligations Incurred	6,012	4,441	3,459	496	4,375	141	34	441	782	20,181
Less: Gross Outlays	6,836	2,199	2,350	286	2,738	24	32	38	5,810	20,313
Less: Recoveries of Prior Year Unpaid Obligations	101	—	—	—	—	—	—	—	227	328
Change in Uncollected Customer Payments from Federal Sources	122	—	—	—	(757)	—	—	(47)	376	(306)
	$1,433	$2,242	$1,109	$210	$880	$117	$5	$356	$1,181	$7,533
Obligated Balance, Net, End of Period										
Unpaid Obligations	$1,449	$2,242	$1,109	$210	$1,637	$117	$5	$404	$1,343	$8,516
Less: Uncollected Customer Payments from Federal Sources	16	—	—	—	757	—	—	48	162	983
Total, Unpaid Obligated Balance, Net, End of Period	$1,433	$2,242	$1,109	$210	$880	$117	$5	$356	$1,181	$7,533
Outlays										
Net Outlays:										
Gross Outlays	$6,836	$2,199	$2,350	$286	$2,738	$24	$32	$38	$5,810	$20,313
Less: Offsetting Collections	115	—	—	—	603	—	—	—	418	1,136
Less: Distributed Offsetting Receipts	—	—	—	—	—	—	—	—	8	8
Net Outlays	$6,721	$ 2,199	$2,350	$286	$2,135	$24	$32	$38	$5,384	$19,169

National Aeronautics and Space Administration
Required Supplementary Information
Fiscal Years 2010 and 2009

DEFERRED MAINTENANCE

NASA uses a Deferred Maintenance parametric estimating method (DM method) in order to conduct a consistent condition assessment of its facilities. This method measures NASA's current real property asset condition and documents real property deterioration. The DM method produces both a cost estimate of deferred maintenance, and a Facility Condition Index (FCI). Both measures are indicators of the overall condition of NASA's facilities. The facilities condition assessment methodology involves an independent, rapid visual assessment of nine different systems within each facility to include: structure, roof, exterior, interior finishes, HVAC, electrical, plumbing, conveyance, and program support equipment. The DM method is designed for application to a large population of facilities; results are not necessarily applicable for individual facilities or small populations of facilities. Under this methodology, NASA defines acceptable operating conditions in accordance with standards comparable to those used in private industry, and the aerospace industry.

There has been no significant change in our deferred maintenance estimate this year. The Agency-wide FCI, based on the ratings obtained during the condition assessment site visits, remains unchanged from the previous fiscal year. The FCI values for the majority of individual Centers and sites varied less than 0.5, validating the relative stability of the Centers and sites despite the continued aging and deterioration of older facilities. Evaluation of the facility conditions by building type (Real Property Classification Code/DM Category) indicates that the Agency continues to focus maintenance and repair on direct mission-related facilities. Higher condition ratings are reported for potable water facilities, launch, communication and tracking, and fuel facilities Agency-wide. Lower condition ratings occur for infrastructure, site related systems, and static test stands.

Deferred Maintenance Method	2010	2009
Facility Condition Index (FCI)	3.6	3.6
Target Facility Index	3.8	3.8
Deferred Maintenance Estimate	$ 2,553	$ 2,547
(Active and Inactive Dollars)		
(In Millions of Dollars)		

National Aeronautics and
Space Administration

Office of Inspector General
Washington, DC 20546-0001

November 15, 2010

TO: Charles F. Bolden, Jr.
Administrator

Elizabeth Robinson
Chief Financial Officer

FROM: Paul K. Martin
Inspector General

SUBJECT: Audit of the National Aeronautics and Space Administration's Fiscal Year 2010 Financial Statements (Report No. IG-11-006; Assignment No. A-10-005-00)

The Office of Inspector General contracted with the independent public accounting firm Ernst & Young LLP (EY) to audit NASA's financial statements in accordance with the Government Accountability Office's *Government Auditing Standards* and the Office of Management and Budget's Bulletin No. 07-04, "Audit Requirements for Federal Financial Statements," as amended.

The audit resulted in a qualified opinion on NASA's fiscal year (FY) 2010 financial statements (Enclosure 1) due to the valuation of property, plant, and equipment (PP&E) and materials in prior years and the possible effects to the current year statements of net cost and changes in net position. A qualified opinion means that except for the effects of the matter to which the qualification relates, the financial statements present fairly, in all material respects, the financial position and the results of the entity's operations in conformity with U.S. generally accepted accounting principles. The results of the FY 2010 audit were a notable improvement over FY 2009 when the Agency received a disclaimer of opinion due to continued weaknesses in internal controls over accounting for legacy PP&E.

EY also issued its reports on internal control and compliance with laws and regulations (Enclosures 2 and 3, respectively). For FY 2010, EY identified two significant deficiencies in financial reporting internal controls involving NASA's (1) controls over PP&E records maintained by contractors and (2) process for estimating environmental remediation costs. While the Agency has made significant progress addressing PP&E issues relating to the valuation and completeness of legacy assets, internal controls can still be enhanced for property managed by contractors and with respect to the Agency's potential environmental liabilities. During the audit, EY identified no instances of significant noncompliance with applicable laws and regulations.

In fulfilling our responsibilities under the Chief Financial Officers Act of 1990, we monitored the progress of the audit, reviewed EY's reports and related documentation, inquired of its representatives, and ensured that EY met contractual requirements. Our review was not intended to enable us to express, and we do not express, an opinion on NASA's financial statements; conclusions about the effectiveness of internal controls over financial reporting; or compliance with certain laws and regulations, including, but not limited to, the Federal Financial Management Improvement Act of 1996.

EY is responsible for each of the enclosed reports and the conclusions expressed therein. Our review, while still ongoing, disclosed no instances where EY did not comply in all material respects with the Government Accountability Office's *Government Auditing Standards.*

Please contact us if you have any questions about the enclosed reports.

3 Enclosures

ERNST & YOUNG

Ernst & Young LLP
1101 New York Avenue, NW
Washington, DC 20005-4213
Tel: +1 202 327 6000
Fax: +1 202 327 6200
www.ey.com

Report on Compliance and Other Matters Based on an Audit of the Financial Statements Performed in Accordance with *Government Auditing Standards*

To the Administrator and the Inspector General
of the National Aeronautics and Space Administration

We have audited the financial statements of the National Aeronautics and Space Administration (NASA) as of and for the year ended September 30, 2010, and have issued our report thereon dated November 15, 2010. That report noted certain matters that resulted in a qualification of our opinion on the consolidated statements of net cost and changes in net position for the year ended September 30, 2010. Except for the matters discussed in the third paragraph of the Report of Independent Auditors, we conducted our audit in accordance with auditing standards generally accepted in the United States, the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States, and Office of Management and Budget (OMB) Bulletin No. 07-04, *Audit Requirements for Federal Financial Statements*, as amended.

As part of obtaining reasonable assurance about whether NASA's financial statements are free of material misstatement, we performed tests of its compliance with certain provisions of laws and regulations, noncompliance with which could have a direct and material effect on the determination of financial statement amounts, and certain other laws and regulations specified in OMB Bulletin No. 07-04, as amended, including the requirements referred to in the Federal Financial Management Improvement Act of 1996. We limited our tests of compliance to these provisions and we did not test compliance with all laws and regulations applicable to NASA.

The results of our tests disclosed no instances of noncompliance with the laws and regulations discussed in the preceding paragraph or other matters that are required to be reported under *Government Auditing Standards* or OMB Bulletin No. 07-04, as amended.

Providing an opinion on compliance with certain provisions of laws and regulations was not an objective of our audit and, accordingly, we do not express such an opinion.

This report is intended solely for the information and use of management and the Office of Inspector General of NASA, OMB, the Government Accountability Office, and Congress, and is not intended to be and should not be used by anyone other than these specified parties.

Ernst + Young LLP

November 15, 2010
McLean, VA

ERNST & YOUNG

Ernst & Young LLP
1101 New York Avenue, NW
Washington, DC 20005-4213
Tel: +1 202 327 6000
Fax: +1 202 327 6200
www.ey.com

Report of Independent Auditors

To the Administrator and the Inspector General
of the National Aeronautics and Space Administration

We have audited the accompanying consolidated balance sheet of the National Aeronautics and Space Administration (NASA) as of September 30, 2010, and the related consolidated statements of net cost and changes in net position and the combined statement of budgetary resources for the fiscal year then ended. We were engaged to audit the consolidated balance sheet of NASA as of September 30, 2009, and the related consolidated statements of net cost and changes in net position and the combined statements of budgetary resources for the fiscal year then ended. These financial statements are the responsibility of NASA's management. Our responsibility is to express an opinion on these financial statements based on our audits.

Except as discussed in the following paragraph, we conducted our audit in accordance with auditing standards generally accepted in the United States, the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States, and Office of Management and Budget (OMB) Bulletin No. 07-04, *Audit Requirements for Federal Financial Statements*, as amended. Those standards and bulletin require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. We were not engaged to perform an audit of NASA's internal control over financial reporting. Our audit included consideration of internal control over financial reporting as a basis for designing audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of NASA's internal control over financial reporting. Accordingly, we express no such opinion. An audit also includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

During fiscal year 2009, NASA continued its focused efforts to resolve legacy issues identified in its financial management processes and systems. Although significant progress had been made, internal controls related to the accounting for property, plant and equipment (PP&E) and operating materials and supplies (OM&S) were determined to be ineffective in fiscal year 2009. As a result of these deficiencies in internal control, we were unable to obtain sufficient competent evidential support for the amounts presented in the consolidated balance sheet as of September 30, 2009, and the related consolidated statements of net cost and changes in net position and the combined statements of budgetary resources for the fiscal year then ended.

Furthermore, these scope limitations affected our ability to audit the following amounts in the accompanying FY 2010 consolidated statements of net costs and changes in net position: (i) the beginning balance of cumulative results of operations; (ii) the cumulative effect of a change in accounting principle for OM&S at October 1, 2009; and (iii) depreciation, PP&E and OM&S related amounts arising from fiscal year 2009 and prior activity, which enter into the determination of amounts included in the net cost of operations for fiscal year 2010.

Because of the matters discussed in the preceding paragraph, the scope of our work was not sufficient to enable us to express, and we do not express, an opinion on the consolidated balance sheet as of September 30, 2009, and the related consolidated statement of net cost, consolidated statement of changes in net position, and combined statement of budgetary resources for the fiscal year then ended.

In our opinion, the fiscal year 2010 financial statements referred to above present fairly, in all material respects, the financial position of NASA as of September 30, 2010, and its budgetary resources for the year then ended, and except for the effects of such adjustments, if any, on the consolidated net cost of operations and consolidated changes in net position of the matters described above in the third paragraph related to PP&E and OM&S balances, its consolidated net cost and consolidated changes in net position for the year ended September 30, 2010, in conformity with accounting principles generally accepted in the United States.

As discussed in Note 6 to the accompanying financial statements, NASA has elected to change its method of accounting for OM&S from the consumption method to the purchases method as allowed under Statement of Federal Financial Accounting Standards No. 3, *Accounting for Inventory and Related Property,* as of October 1, 2009.

In accordance with *Government Auditing Standards* and OMB Bulletin No. 07-04, *Audit Requirements for Federal Financial Statements*, as amended, we have also issued our reports dated November 15, 2010, on our consideration of NASA's internal control over financial reporting and on our tests of its compliance with certain provisions of laws, regulations, and other matters. The purpose of those reports is to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing and not to provide an opinion on the internal control over financial reporting or on compliance. Those reports are an integral part of an audit performed in accordance with *Government Auditing Standards* and OMB Bulletin No. 07-04, as amended, and should be considered in assessing the results of our audit.

Our audits were conducted for the purpose of forming an opinion on the 2010 and 2009 basic financial statements taken as a whole. The information presented in Management's Discussion and Analysis, required supplementary stewardship information, required supplementary information, and other accompanying information, is not a required part of the basic financial statements but is supplementary information required by OMB Circular No. A-136. The other accompanying information has not been subjected to the auditing procedures applied in our audit of the basic financial statements and, accordingly, we express no opinion on it. For the remaining information, we have applied certain limited procedures, which consisted principally of inquiries of management regarding the methods of measurement and presentation of the supplementary information. However, we did not audit the information and express no opinion on it.

Ernst & Young LLP

November 15, 2010
McLean, VA

Ernst & Young LLP
1101 New York Avenue, NW
Washington, DC 20005-4213
Tel: +1 202 327 6000
Fax: +1 202 327 6200
www.ey.com

Report on Internal Control Over Financial Reporting Based on an Audit of the Financial Statements Performed in Accordance with *Government Auditing Standards*

To the Administrator and the Inspector General
of the National Aeronautics and Space Administration

We have audited the financial statements of the National Aeronautics and Space Administration (NASA or the Agency) as of and for the year ended September 30, 2010, and have issued our report thereon dated November 15, 2010. That report noted certain matters that resulted in a qualification of our opinion on the consolidated statements of net cost and changes in net position for the year ended September 30, 2010. Except for the matters discussed in the third paragraph of the Report of Independent Auditors, we conducted our audit in accordance with auditing standards generally accepted in the United States; the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States; and Office of Management and Budget (OMB) Bulletin No. 07-04, *Audit Requirements for Federal Financial Statements,* as amended.

In planning and performing our audit, we considered NASA's internal control over financial reporting as a basis for designing our auditing procedures for the purpose of expressing our opinion on the financial statements, but not for the purpose of expressing an opinion on the effectiveness of NASA's internal control over financial reporting. Accordingly, we do not express an opinion on the effectiveness of NASA's internal control over financial reporting. We limited our internal control testing to those controls necessary to achieve the objectives described in the OMB Bulletin No. 07-04, as amended. We did not test all internal controls relevant to operating objectives as broadly defined by the Federal Managers' Financial Integrity Act of 1982 (FMFIA), such as those controls relevant to ensuring efficient operations.

A deficiency in internal control exists when the design or operation of a control does not allow management or employees, in the normal course of performing their assigned functions, to prevent, or detect and correct misstatements on a timely basis. A *material weakness* is a deficiency, or a combination of deficiencies, in internal control such that there is a reasonable possibility that a material misstatement of the entity's financial statements will not be prevented, or detected and corrected on a timely basis.

Our consideration of internal control over financial reporting was for the limited purpose described in the preceding paragraph and was not designed to identify all deficiencies in internal control that might be deficiencies, significant deficiencies or material weaknesses and, therefore, there can be no assurance that all deficiencies, significant deficiencies, or material weaknesses have been identified. We did not identify any deficiencies in internal control that we consider to be material weaknesses, as defined above. However, we identified certain deficiencies in internal control over financial reporting, described below, that we consider to be significant deficiencies in internal control over financial reporting.

A significant deficiency is a deficiency, or a combination of deficiencies, in internal control that is less severe than a material weakness, yet important enough to merit attention by those charged with governance. We consider the deficiencies related to Enhancements Needed for Controls over Property, Plant & Equipment Records Maintained by Contractors and Enhancements Needed for Recognition of Environmental Remediation Costs to be significant deficiencies.

Significant Deficiencies

Enhancements Needed for Controls over Property, Plant & Equipment Records Maintained by Contractors (new deficiency)

Prior-year audit reviews of NASA's legacy property, plant & equipment (PP&E) identified serious weaknesses in the design of internal controls over the completeness and accuracy of legacy assets, particularly in relation to the International Space Station (ISS) and Space Shuttles, which prevented material misstatements from being detected and corrected in a timely manner by NASA. During FY 2009 and FY 2010, NASA management undertook a systematic process to address the valuation and completeness issues related to the ISS and Space Shuttle assets as well as other PP&E in connection with the release of the Federal Accounting Standards Advisory Board (FASAB) Statement of Federal Financial Accounting Standards (SFFAS) No. 35, *Estimating the Historical Cost of G-PP&E*. This standard permits use of estimate approaches, which substantially improved NASA's ability to account for these assets in accordance with generally accepted accounting principles (GAAP) in FY 2010. Also assisting in remediation of this finding was that Space Shuttle assets have been fully depreciated in FY 2010 as they have reached the end of their estimated useful lives and this timing reasonably coincides with the Space Shuttle Transition and Retirement program. In addition, NASA reassessed and concluded that certain property classified as operating materials and supplies should be accounted for by the purchases method and not reflected on the NASA balance sheet as an asset. Adoption of changes in the internal control process associated with new contracts implemented in prior years also assisted in resolution of legacy property issues. Notwithstanding this significant progress, internal controls related to PP&E can continue to be enhanced, with particular emphasis on the approaches used to validate property managed by contractors. With many of the most intractable issues resolved through implementation of SFFAS No. 35, the remaining matters merit continued focus.

NASA is heavily dependent on activities at its contractors to recognize assets created at its contractors and the contractors' reporting of property transactions via the Contractor Held Asset Tracking System (CHATS) and quarterly reporting detail. All NASA contractors have their own procedures and systems for maintaining, valuing, inventorying and accounting for NASA property. Certain contractors report contractor-held property balances maintained on NASA's

behalf monthly/quarterly via CHATS. These transactions are then recorded in the Asset Accounting module of SAP by NASA to reflect the capitalized balances associated with contracts that have been determined to meet NASA's capitalization policy. The remaining contractors report their NASA-owned properties annually.

Over the past several years, NASA has developed a suite of overarching detect controls to assist in mitigating the risk of a material financial statement error in the property accounts. An example of these detect controls is the Continuous Monitoring Program conducted by center and agency-level personnel on a routine basis to assist NASA in identifying and correcting errors and discrepancies in a timely manner, as well as confirming that ongoing management reviews and validations of financial data and internal controls are taking place. Another example includes the validation procedures over property amounts reported by the contractors via CHATS as well as a reconciliation of CHATS property balances to those recorded by NASA in the Asset Accounting module of SAP, such that contracts and property deemed by NASA to be research and development are excluded from NASA's balance sheet. These overarching monitoring controls coupled with agency-wide budgetary controls were established to detect errors of significance to the financial statements. While relatively less direct NASA involvement has been devoted to ensuring that contractor controls are functioning as designed, the broad requirements for contractor property management systems are reflected in contract terms. NASA has some visibility into how individual contractors design and operate their property management systems through the Defense Contract Management Agency (DCMA) reviews and the activities of property administrators, as well as through limited Defense Contract Audit Agency (DCAA) reviews. The timing and scope of these reviews do not always facilitate timely recognition of issues, or provide NASA with a basis of reliance on the procedures absent further efforts by NASA.

Most notable of NASA's contractor-held related property is the ISS, which at September 30, 2010, represented approximately $6.3 billion or 66% of NASA's total property balance. The majority of the ISS costs capitalized is derived from one contractor. During the current fiscal year, this contractor reported inaccuracies in its quarterly submissions of data to NASA via CHATS. Specifically, in the second quarter reporting submission, upon delivery of the final ISS components to NASA (the United States On-Orbit Segment), the contractor reported a decrease in its work-in-process, but did not appropriately reflect a corresponding increase in its other property balances as submitted to NASA. NASA management discovered and questioned the contractor regarding these unusual relationships as part of their validation and monitoring process, and elected to not record changes to their property records in the general ledger for the questioned items, pending further review. In the contractor's third quarter reporting submission, the contractor reported a $1.1 billion adjustment. NASA was unaware of the details and justification for this adjustment at the time of submission. Again, NASA elected to not record changes to their property records pending further review and validation with the contractor. During the fourth quarter, NASA recorded a $644 million adjustment to account for the second

quarter error and NASA management invalidated the $1.1 billion adjustment reported by the contractor in the third quarter. The process NASA used to correct such items validates the effectiveness of some of the financial management review processes to detect errors of financial statement significance. However, identification of a further potential adjustment initially proposed by a contractor late in FY 2010 and ultimately not made, highlights the need for NASA to continue to work with contractors to develop robust controls to prevent errors in the underlying records and the initial submission of data from its contractors, such that items of significance are agreed to by NASA and the contractors prior to submission in CHATS and can be recorded by NASA in a timely manner to facilitate the preparation of quarterly financial statements and other reports.

At our request, NASA performed high-level analytic reviews and then deconstructed FY 2010 property-related activity and critically assessed whether the interrelationships within the recorded amounts comported with management's understanding of expected results based on the activities executed during the year, which might reasonably have been expected to give rise to accounting entries. This effort, which highlighted a number of anomalies, including previously unexplained variations in depreciation and accumulated depreciation amounts, and differences between estimates of contractor-held property activity reflected in accrual estimates and actual amounts as reflected in subsequent contractor reporting, was useful in correcting misstatements before issuance of the FY 2010 financial statements and in assessing the largely offsetting impacts of differences on prior reported amounts. The interactions with Centers, contractors and property management personnel required to understand the flows reflected were useful in enhancing NASA's understanding of its recorded amounts and proposed adjustments. These efforts were complicated by NASA processes which do not facilitate identification of net property addition or deletion activity, with transfers between line item classifications, between contractors, and between contractors and the government each recorded in the detail records. Customized reporting is not yet sufficiently refined to facilitate the analysis. Management acknowledges that these overarching analytical techniques are under development, and will be critical aspects of NASA's ability to report and interpret property-related activities.

Recommendation

Based on the significant reliance placed on contractor systems, we suggest that management revisit the extent to which such systems merit improvement in controls and revisit the extent of independent testing performed to assist in reducing the possibility that errors that are other than inconsequential may occur and not be detected by the system of overarching detect controls NASA has put in place.

We recommend that NASA:

1. Continue to enhance its understanding of the design, implementation and functioning of control activities in place at its contractors and assess the extent to which further refinement is needed to assist in preventing errors or their early detection and correction within the contractors.
2. Revisit the extent of evaluation and testing of property-related systems under the OMB Circular No. A-123 process, DCAA activities or potentially other constructs, including assessing the merits of obtaining more timely and comprehensive assurance regarding contractor systems of internal control in light of the significance of the amounts processed in relation to the financial statements and assets of NASA.
3. Develop preventative controls with its contractors on items of significance prior to the contractors' submissions of property data to NASA. Co-developing thresholds for validation and concurrence prior to the submission process with the contractor is key to the development of an effective control.
4. Continue to refine the PP&E analytic tools developed late in FY 2010 to assist in conducting reasonableness reviews and further assessing the fair presentation of NASA property activity on at least a quarterly basis. This effort should include developing customized reporting tools to access and summarize in readily interpreted formats the information reflected in NASA's property records.

Enhancements Needed for Recognition of Environmental Remediation Costs (modified repeat deficiency)

NASA's environmental liability is estimated at $1,041 million as of September 30, 2010, including the estimated environmental cleanup cost associated with PP&E. We noted that the NASA Office of the Chief Financial Officer (OCFO) and the Office of Strategic Infrastructure (OSI) invested resources to enhance internal controls for its contingent environmental remediation liabilities. The joint review process, a key control, further matured in FY 2010 by improving training and consistency to the environmental remediation estimation process. NASA also retained a third-party consultant to develop an estimate of the environmental cleanup costs for PP&E not related to the Space Shuttle Program (SSP). While NASA continues to make progress, we noted weaknesses in NASA's ability to generate a consistent estimate of its contingent environmental remediation costs and its environmental cleanup costs associated with PP&E. Specifically:

1. NASA lacks an ongoing validation program to assess the accuracy of remedial estimates generated through the use of the Integrated Data Evaluation and Analysis Library (IDEAL) tool. NASA uses algorithms in the IDEAL tool to develop remediation estimates when detailed user-defined engineering estimates are not available. The algorithms were checked against actual results in a series of studies conducted in 2007

and 2008. Differences were noted in these studies and recommendations were made to improve the tool's performance. However, NASA has not developed and implemented a process to periodically validate and update the model based on actual costs.

2. Reasonably possible and estimable and reasonably possible and non-estimable disclosures can be enhanced by the joint review process: The joint review process does not consistently include documentation of the review and classification of costs other than those that are probable and estimable.

3. SFFAS No. 6 costs are categorized in SFFAS No. 5 data sets: In FY 2009, NASA updated its environmental liability process to differentiate those liabilities that are remedial in nature and recognized in accordance with SFFAS No. 5 *Accounting for Liabilities of the Federal Government,* and those environmental cleanup liabilities that are known when the asset is placed in service and recognized in accordance with SFFAS No. 6. Certain landfill operations, storage tanks and the decommissioning of Plum Brook nuclear reactor are environmental cleanup and closure obligations. NASA has not reclassified these estimates, in some cases because the cleanup has historically been included in the SFFAS No. 5 environmental liability but has elements of a SFFAS No. 6 liability as well.

4. Environmental control processes are not updated in a timely manner: NASA Procedural Requirement (NPR) 8590.1, *NASA Environmental Compliance and Restoration (ECR) Program*; (effective June 14, 2007 and updated in 2010) does not reference the joint process review, a key control in the review of unfunded environmental liabilities. The joint process reviews have been a critical control in the annual estimation process since FY 2008. Furthermore, NPR 9260.1 *Revenue, Unfunded Liabilities and Other Liabilities* (effective September 30, 2008) does not capture the process used to gather PP&E cleanup costs related to the Space Shuttle or other applicable programs.

   The procedures engaged in by the Space Operations Mission Directorate (SOMD) to develop the estimate of SSP PP&E cleanup costs are based on efforts necessary to adhere to annual planning, programming, budgeting and execution (PPBE) requirements. These steps and support are then modified by the SOMD to project probable and reasonably possible environmental liabilities used for financial reporting. Current NASA guidance does not specify the actions to be taken by OCFO to review, recognize, or record the estimate or identify control activities or procedures to aid in ensuring that the recorded amounts are appropriate.

5. NASA has not completed its development of procedures or estimates to record and disclose asbestos cleanup costs. During our testing at the Marshall Space Flight Center (MSFC) we were made aware of an Asbestos Information System database that housed information on both friable and non-friable asbestos located in buildings and equipment throughout MSFC that did not pose an immediate health hazard. NASA's management has stated that asbestos cleanup costs associated with friable asbestos that constitutes an

immediate health hazard are recognized when identified. NASA indicated that costs for the removal of friable and nonfriable asbestos that does not pose an immediate health hazard but that will be removed in connection with a future demolition or modification have not been recorded. NASA indicated that it will be required to recognize those costs in FY 2012 under applicable guidance. The applicable FASAB guidance deferring recognition of certain asbestos costs that do not pose an immediate health hazard in connection with implementation of SFFAS No. 6 acknowledges the difficulties agencies may have in developing comprehensive inventories of such materials and cleanup estimates. Further refinement of NASA processes in these areas may be required to meet the objectives of SFFAS No. 6.

Recommendation

Notwithstanding that progress has been made during FY 2010, we suggest that management revisit the internal controls related to NASA's ability to generate a consistent estimate of its contingent environmental remediation costs and its environmental cleanup costs associated with PP&E to assist in reducing the possibility that errors that are other than inconsequential may occur and not be detected by the system of overarching detect controls NASA has put in place.

We recommend that NASA:

1. Complete the development and implementation of the application controls that ensure the accuracy of the output (e.g., cost tables, markups, and contingencies). This includes completing and documenting the verification of the IDEAL parametric model output and aggregation functions to validate the reliability of the output.
2. Amend the joint review process documentation to require the classification of costs that are other than probable and estimable into assigned categories (e.g., probable but not-estimable, reasonably possible and estimable, reasonably possible but not estimable, and remote) and retain documentation related to significant judgments regarding responsible parties, classification and components of the estimates.
3. Reclassify environmental liabilities that are managed as contingent environmental liabilities in accordance with SFFAS No. 5 and that are more appropriately managed as environmental cleanup costs in accordance with SFFAS No. 6.
4. Update or develop a separate process for NPR 8590.1, *NASA Environmental Compliance and Restoration (ECR) Program* to reference the joint process review and NPR 9260.1, *Revenue, Unfunded Liabilities and Other Liabilities,* with the process to be developed as pertaining to PP&E cleanup estimation procedures for program transition and retirement efforts, or craft a separate process to capture these concerns.

5. Implement preventative actions (i.e., controls) to address policies, procedures and guidance related to the SSP PP&E cleanup estimation process. Specifically, assign roles and responsibilities for implementation of completeness and valuation testing procedures to relevant OSI and OCFO personnel. Estimation procedures should also be compared to assess compliance with SFFAS No. 6, Technical Release 2 and Technical Release 11 guidance.
6. Facilitate the development of a procedure, in conjunction with other appropriate NASA entities (e.g., Environmental Management Division, Health and Safety, Facilities Management), to identify, estimate and document friable and nonfriable asbestos abatement costs in circumstances in which an immediate health hazard does not exist in accordance with the applicable FASAB guidance prior to its effective date.

Other Matters

STATUS OF PRIOR-YEAR FINDINGS

In the reports on the results of the FY 2009 audit of the NASA's financial statements, a number of issues were raised relating to internal control. The chart below summarizes the current status of the prior year items:

Material Weakness		
Issue Area	**Summary Control Issue**	**FY 2010 Status**
Enhancements Needed for Controls over Legacy PP&E and Materials Contracts, But SFFAS No. 35 Adoption May Aid In Resolving This Longstanding Issue	• Certain legacy issues noted in prior-year audit reports continue to challenge the Agency, particularly in relation to the ISS and Space Shuttles. SFFAS No. 35 is expected to substantially improve NASA's ability to account for these assets in accordance with GAAP in FY 2010.	Substantially remediated. New observation related to SFFAS No. 35 implementation and contractor-held property reflected herein as a significant deficiency.

Significant Deficiencies		
Issue Area	**Summary Control Issue**	**FY 2010 Status**
Processes in Estimating NASA's Environmental Liability Continue to Require Enhancement	• Design and implementation of controls for NASA's IDEAL estimating software have not been completed. • Certain controls surrounding the process to value unfunded environmental liabilities need further enhancements.	Significant progress has been noted; but deficiencies still remain as reported as a significant deficiency herein.
Financial Management Systems Not in Substantial Compliance with Federal Financial Management Improvement Act	• Real property system not integrated with the Core Financial Module • Issues related to IT access and change management identified • NASA did not meet certain requirements to ensure compliance with federal accounting standards.	Substantially remediated. Significant improvements noted with the integration of the real property system to the core financial module and the implementation of SFFAS No. 35 to overcome certain issues within the property area. Certain less significant matters and interrelationships with the work of other auditors have been brought to the attention of management.

* * * * *

We have reviewed our findings and recommendations with NASA management. Management generally concurs with our findings and recommendations and will provide a corrective action plan to address the findings identified in this report. We did not audit NASA's response, and accordingly, we express no opinion on it.

This report is intended solely for the information and use of the management and the Office of Inspector General of NASA, OMB, the Government Accountability Office and Congress, and is not intended to be and should not be used by anyone other than these specified parties.

Ernst & Young LLP

November 15, 2010
McLean, VA

Management's Response to Independent Auditor's Report for Fiscal Year 2010

National Aeronautics and Space Administration
Headquarters
Washington, DC 20546-0001

November 15, 2010

Reply to Attn of:
Office of the Chief Financial Officer

TO: Inspector General

FROM: Deputy Chief Financial Officer

SUBJECT: Management Response to Audit Report of Independent Auditors

I am pleased to respond to your audit report on the Consolidated Financial Statements of the National Aeronautics and Space Administration (NASA) for FY 2010 and FY 2009. NASA's efforts and achievements toward improved financial management are clearly reflected in the audit opinion. For the first time since 2002, NASA has earned an unqualified opinion with no material weaknesses on its Consolidated Balance Sheet and Combined Statement of Budgetary Resources. I am confident that the same will be said for our Consolidated Statements of Net Cost and Changes in Net Position next year.

I am particularly gratified to note NASA's resolution of the prior year material weakness in internal controls related to the Agency's legacy Property, Plant, and Equipment (PP&E). This is a direct result of the commitment and effort to financial management by the entire Agency and a clear indication of the progress that the Agency continues to make toward a fully unqualified audit opinion. As a result of successful efforts to integrate property information with the financial accounting system, NASA is now substantially compliant with the Federal Financial Management Improvement Act.

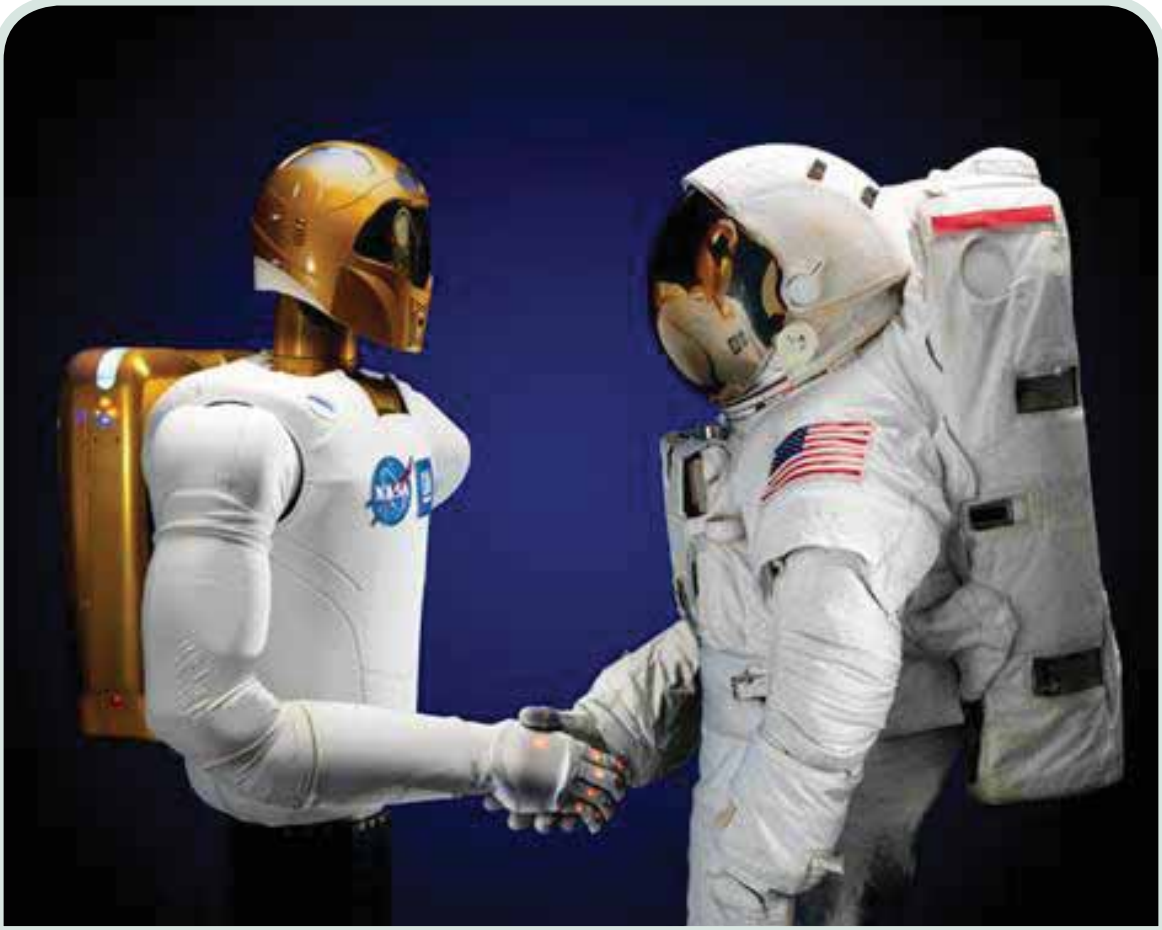
I understand that the independent auditors identified two significant deficiencies, one related to controls over PP&E records maintained by contractors and the other related to the need for enhancements over NASA's recognition of environmental remediation costs. The Agency is committed to working collaboratively, with the Office of Inspector General (OIG) and the independent audit firm in resolving these deficiencies as quickly as possible.

I appreciate the efforts of the OIG and of the independent auditors under contract to the OIG to audit NASA's financial statements. Please convey my appreciation and thanks to your staff for the professionalism and cooperation exhibited during this audit.

Terry Bowie

This page deliberately left blank.

Other Accompanying Information



Credit: NASA

Robonaut 2, a dexterous, humanoid astronaut helper, will fly to the International Space Station aboard Space Shuttle *Discovery* on the STS-133 mission. Although it will initially only participate in operational tests, upgrades could eventually allow the robot to realize its true purpose—helping spacewalking astronauts with tasks outside the Station.

National Aeronautics and
Space Administration

Office of Inspector General
Washington, DC 20546-0001

November 12, 2010

TO: Charles F. Bolden, Jr.
Administrator

FROM: Paul K. Martin
Inspector General

SUBJECT: NASA's Top Management and Performance Challenges

As required by the Reports Consolidation Act of 2000, the enclosed report provides our views of the most serious management and performance challenges facing NASA. This document will be included in the Agency's Performance and Accountability Report for fiscal year 2010.

In determining whether to identify an issue as a top challenge, we consider the significance of the issue in relation to the Agency's mission; its susceptibility to fraud, waste, and abuse; whether the underlying matter is systemic; and the Agency's progress in addressing the challenge. To its credit, NASA has made a concerted effort over the past several years to improve its management practices and address weaknesses identified by the Agency, the Office of Inspector General (OIG), and other oversight bodies. Nevertheless, significant challenges remain across all NASA programmatic and functional areas.

We believe the following issues constitute the top management and performance challenges currently facing the Agency:

- Future of U.S. Space Flight
- Acquisition and Project Management
- Infrastructure and Facilities Management
- Human Capital
- Information Technology Security
- Financial Management

In finalizing this report, we provided a draft copy of our views to Agency officials and considered all comments received.

Finally, during the coming year the OIG will continue to conduct audits, investigations, and reviews that focus on NASA's efforts to address these and other important challenges. We hope that you find this report helpful.

Enclosure

NASA's Top Management and Performance Challenges
November 2010

Introduction

Throughout the past year, NASA has been in the midst of its most significant period of transition since the end of the Apollo era: the Space Shuttle is close to retirement after 30 years and more than 130 flights; construction of the International Space Station (ISS) is complete; and the future of the Constellation Program, the Agency's marquee human space flight program, was in doubt. Enactment of the National Aeronautics and Space Administration Authorization Act of 2010 (Authorization Act) in October clarified several important aspects of NASA's future mission, including clear direction to cancel much of the Constellation Program in favor of commercially operated crew transportation to the ISS and a detailed directive to develop a multi-purpose crew vehicle and heavy-lift launch system. However, NASA (and all other Federal Government agencies) remains in a holding pattern with respect to receiving its full fiscal year (FY) 2011 funding at least until December 2010. Until its FY 2011 appropriation is enacted, NASA is limited in the steps it can take to close out the Constellation Program and move forward on the priorities outlined in the Authorization Act. Consequently, one of the top challenges for NASA leadership is to manage the Agency's portfolio of core science, aeronautics, and human space flight and exploration missions amid this continuing lack of clarity. Moreover, when a FY 2011 budget is enacted NASA managers will need to reconcile any differences between the appropriations legislation and the Authorization Act.

To its credit, NASA has made a concerted effort over the past several years to improve its management practices and address systemic weaknesses identified by the Agency, the Office of Inspector General (OIG), and other oversight bodies. Nevertheless, significant challenges remain across all NASA programmatic and functional areas. This annual report highlights several issues we believe pose the top management and performance challenges to NASA leadership, specifically:

- Future of U.S. Space Flight
- Acquisition and Project Management
- Infrastructure and Facilities Management
- Human Capital
- Information Technology Security
- Financial Management

In deciding whether to identify an issue as a top management and performance challenge, we considered the significance of the issue in relation to the Agency's mission; its susceptibility to fraud, waste, and abuse; whether the underlying issues are systemic in nature; and the Agency's

progress in addressing the challenge. Several of these challenges, specifically acquisition and project management and infrastructure and facilities management, are long-standing concerns likely to remain top challenges for the foreseeable future. However, with focused and sustained efforts we believe that NASA leaders can make significant strides in addressing all of these challenges.

1. Future of U.S. Space Flight

Throughout NASA's history, transitioning from a legacy flight system to the next system has always presented significant challenges. The retirement of the Space Shuttle Program and transition to the next generation of space vehicles is no exception.

The Shuttle Program, originally planned for retirement at the end of FY 2010, will now continue to fly well into FY 2011. Moreover, after extensive cost and schedule overruns, concerns about adequate long-term funding, and much political debate, the Constellation Program – which was expected to produce the next generation of NASA space vehicles – has been terminated, surviving only in the form of as yet undefined crew transport and heavy-lift vehicles.

Moreover, the Agency's efforts to stimulate the emerging U.S. commercial space industry to more independently develop vehicles to transport cargo and crew represent a departure from NASA's past approach to space flight and consequently present a significant management challenge.

Transition and Retirement of the Space Shuttle Program. Foremost among NASA's Shuttle-related priorities is the need to safely complete the Program's two or three remaining flights. At the same time, transitioning from and retiring the Space Shuttle Program presents one of the top challenges facing the Agency. As the OIG noted in its March 2010 report, "Review of NASA's Progress on Retiring the Space Shuttle Program," NASA was unable to complete the remaining planned Shuttle flights by the end of FY 2010 as initially planned, and rescheduled the final flights for November 2010 and February 2011.[1] While the Authorization Act provides for an additional Shuttle mission to be flown no earlier than June 1, 2011, it remains to be seen whether NASA will obtain the funding needed to support this extra flight.

In addition to managing Shuttle funding challenges, the transition and retirement activities associated with the end of the Shuttle Program present one of the largest such efforts ever undertaken by NASA. The Shuttle Program is spread across hundreds of locations, occupies over 654 facilities, and involves more than 1.2 million line items of personal property with a total equipment acquisition value exceeding $12 billion. The challenge of dealing with all of this infrastructure and personal property has been further complicated by termination of the Constellation Program, which was slated to use much of the Shuttle Program's infrastructure, and language in the Authorization Act that directs NASA to develop a multi-purpose crew vehicle and heavy-lift launch system. The OIG is currently examining NASA's transition and retirement efforts for the Shuttle Program given the significance and magnitude of this effort.

[1] NASA's attempt to launch space shuttle Discovery in early November was thwarted by a series of technical problems. The mission was rescheduled for launch no earlier than November 30, 2010.

Finally, Agency managers continue to address the challenge of retaining the skilled workforce necessary to safely fly out the remaining Shuttle missions while simultaneously making personnel cuts necessary to retire the Program.

Commercial Launch Providers. Once the Space Shuttle has flown its last flight, NASA will need to rely on other countries for access to the ISS until either it develops its own follow-on system or a commercial vehicle is proven capable of carrying cargo and humans into space. With respect to cargo, NASA has been working to develop commercial providers for the past several years through its Commercial Orbital Transportation Services (COTS) Program. After a series of delays, the first COTS demonstration flight is scheduled for December 2010 by Space Exploration Technologies Corporation (SpaceX).

Efforts to develop commercial vehicles capable of carrying humans to the ISS and other low Earth orbit destinations present significant challenges. One issue of particular complexity is NASA's intent to "human-rate" any new flight system, whether developed commercially or by NASA. NASA only recently developed comprehensive human-rating standards for NASA-developed systems, and the certification process that will be used to human-rate commercial vehicles – several of which are already well under development – is not yet fully defined. Given the importance of this issue, the OIG is examining NASA's development of human-rating standards for commercial vehicles and will evaluate how commercial space transportation providers intend to implement NASA's safety and human-rating requirements.

Adding to this challenge is NASA's need to select an acquisition strategy for developing a commercial capability for crew transportation. Specifically, NASA must decide how it intends to partner with commercial providers in the development of new space vehicles for human space flight. In doing so, NASA must balance its role as a partner of commercial providers with its responsibility to ensure that commercially produced vehicles are safe for NASA astronauts.

NASA also faces challenges related to the U.S. market for medium-class launch vehicles suited for many NASA science missions, a market segment that has suffered from foreign competition and lack of demand by non-Government customers. While new launch vehicles in this class are currently under development as part of NASA's COTS Program, in the near-term NASA faces limited domestic availability of medium-class launch vehicles for its science missions. This situation has been exacerbated by the Department of Defense's decision to stop using the Delta II, the medium-class launch vehicle that has been NASA's launch vehicle of choice for nearly 60 percent of its science missions over the last decade.

NASA Transportation Systems. The Authorization Act represents somewhat of a compromise between those who believe NASA should continue to develop its own space transportation systems (like Constellation) and those who believe NASA should rely on commercial launch providers for access to the ISS and low Earth orbit. Specifically, the Act directs NASA to foster development of commercial cargo and crew capabilities while simultaneously developing its own launch system and crew vehicle. Addressing both of these responsibilities presents a significant management challenge for NASA leadership.

Moreover, the level of specificity contained in the Authorization Act regarding the design and development of NASA's launch system presents its own challenges. For example, the

Authorization Act directs NASA to develop a heavy-lift vehicle capable of reaching and transiting beyond low Earth orbit, carrying a new crew vehicle, and serving as a backup for supplying cargo and crew to the ISS. In addition, the Authorization Act encourages the extension of existing vehicle development contracts associated with the Constellation Program. This latter directive may limit NASA's ability to move away from the design of the Constellation launch vehicle to explore alternative architectures.

Similarly, the crew vehicle called for in the Authorization Act appears similar in design to the Constellation Program's Orion Crew Exploration Vehicle. However, the history and development challenges of Orion have been well documented by the Government Accountability Office (GAO), the NASA Advisory Council, and the Aerospace Safety Advisory Panel. For example, because of concerns about excess weight and in order to improve schedule and cost confidence, the original six-person design was modified in 2009 to a four-person configuration.

International Space Station. After years of development, construction of the ISS is complete. The Authorization Act extends the life of the ISS until at least 2020 and directs NASA to maximize its productivity and use with respect to scientific and technological research and development, advancement of space exploration, and international collaboration. The Act also instructs NASA to provide initial financial assistance to and enter into a cooperative agreement with a non-profit organization to manage the activities of the ISS national laboratory. Both of these directives present significant management challenges. As discussed above, the retirement of the Space Shuttle signals an end to the United States' ability, at least in the short term, to transport supplies and experiments to the ISS, and NASA will be dependent upon the Russians to transport astronauts to the ISS until commercial vehicles are available. In addition, NASA needs to continue to develop incentives and partnerships to encourage use of the ISS by other U.S. Government agencies, other nations, and the commercial sector.

2. Acquisition and Project Management

Effective acquisition and project management are critical to NASA's ability to achieve its overall mission, but systemic weaknesses in these areas have proven a long-standing challenge for the Agency. The OIG is focusing increased attention on these issues to help ensure that NASA is paying contractors in accordance with contract terms and is receiving what it paid for on schedule.

Cost and Schedule Estimates. NASA historically has struggled with establishing realistic cost and schedule estimates for the projects in its portfolio, with OIG and GAO reviews identifying cost growth and schedule slippage in the majority of the Agency's major projects.

Both the OIG and GAO have found that cost growth and schedule slippage in NASA programs is often due to the Agency's failure to address systemic acquisition management weaknesses related to requirements growth, cost estimating, technology development, design stability, funding, and system integration. For example, in February 2010 GAO conducted an assessment of NASA's 19 most costly projects (combined life-cycle cost of $66 billion) and found that within the last 3 years, 10 of the 19 projects experienced cost growth averaging $121.1 million or

18.7 percent, while the average schedule delay was 15 months.[2] GAO found that the cost growth and schedule slippage resulted, in part, from failing to adequately identify requirements and underestimating complexity and technology maturity.

One program in particular, the James Webb Space Telescope, is emblematic of the problems NASA has faced in developing realistic cost and schedule estimates. In July 2003, NASA scheduled the Webb Telescope for launch in August 2011 at an estimated cost of $1.6 billion. In succeeding years, the planned launch date slipped to June 2014 and the estimated total life-cycle cost increased to $5.09 billion. Concern over growing cost and schedule delays with Webb prompted a June 2010 congressional request for an independent review of the program. This assessment, released publicly on November 10, cited problems with budgeting and program management rather than technical performance as the reasons for the delays and increases in costs for NASA's flagship science project. The report concluded that Webb's earliest possible launch date of September 2015 was dependent on the project making a series of critical management changes coupled with an infusion of an additional $500 million over and above the funds already identified for the project in the President's FY 2011 and FY 2012 budget profile.

Project Management. To execute projects within established cost and schedule estimates, NASA needs to maximize the use of a wide range of project management tools including earned value and risk management. While effective project management historically has been a major challenge, NASA has shown that it can use these project management tools to produce positive results. For example, during the past year we found that managers for the Tracking and Data Relay Satellite (TDRS) K and L Project implemented a robust risk management process and made informed decisions based on earned value management data. As a result, development of two replacement satellites was within budget and on schedule. Conversely, NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) Program lacked an effective cost control process and experienced such significant cost growth early in development that the project was nearly canceled. Even though TDRS K and L are the 11th and 12th satellites built for the program while many other NASA projects are unique instruments, the challenge for NASA is to use sound management tools to identify and mitigate programmatic risks in all of its projects.

Contract Management. NASA spends approximately 85 percent of its $18 billion budget on contracts and awards. Given the significant amounts of taxpayer funds at risk, continued findings by the OIG and GAO identifying systemic weaknesses in NASA's contract management practices illustrate that this issue remains a top Agency challenge. For example, the OIG has identified instances of fraud, waste, and abuse by program participants that bring into question the effectiveness of the internal controls in NASA's Small Business Innovation Research (SBIR) Program. OIG investigations have found that some award recipients received multiple SBIR contracts for essentially the same research and provided duplicate deliverables or questionable research products. An ongoing OIG audit of NASA's SBIR Program is examining whether Program management has implemented adequate internal controls to ensure the contract funds are appropriately spent. In addition, the audit is reviewing whether SBIR contracts contain unallowable and unsupported costs.

[2] GAO: "NASA: Assessments of Selected Large-Scale Projects" (GAO-10-227SP, February 1, 2010).

In another area of contract management, we found that NASA could improve its award fee structure in some contracts to motivate higher performance. For example, NASA's contract with the Zero Gravity Corporation (Zero G) to provide microgravity flight services permits the company to earn 100 percent of the available award fee if Zero G flies only 60 percent successful parabolas. We recommended that NASA revise the contract's performance-based payment structure so that payments more accurately reflect the contractor's performance.

GAO has also reported that NASA's award-fee payments to contractors did not always translate into desired program outcomes. For example, NASA paid the contractor for the Earth Observing System Data and Information System 97 percent of the available award fee despite a delay in completion of the contract of over 2 years and an increase in cost of more than 50 percent.[3] The GAO also found that NASA had not evaluated the overall effectiveness of award fees and did not have metrics in place for conducting such evaluations. The report made a series of recommendations, which NASA has since implemented, aimed at tying award-fee payments to desired outcomes. Because cost-plus-award-fee contracts account for almost half of NASA's obligated contract dollars, NASA will continue to face challenges in this area.

3. Infrastructure and Facilities Management

NASA is the ninth largest Federal Government property holder, controlling a network of approximately 5,400 buildings and structures that support Agency research, development, and flight activities. NASA's ability to effectively manage the necessary maintenance and renovation of this large and aging portfolio of facilities is a critical challenge facing the Agency.

Maintenance, Repair, and Use of Aging Facilities. For years, NASA has struggled with its aging and underutilized infrastructure and the related issue of managing its backlog of deferred maintenance projects. According to NASA's 2008 Real Property Asset Management Plan, approximately 10 to 50 percent of NASA's warehouses and 30 to 60 percent of its laboratories are underutilized. NASA officials also report that more than 80 percent of the Agency's facilities are 40 or more years old and beyond their design life. Under its current policy, NASA is required to maintain these facilities to keep them operational or, if they are not being used, to ensure they do not pose a safety hazard. In FY 2009, NASA reported spending approximately $283 million to repair and maintain its facilities, while Agency-wide deferred maintenance costs that year were estimated at $2.55 billion.[4]

The Aerospace Safety Advisory Panel cited NASA's aging facilities as an area of concern in its most recent annual report, and NASA's backlog of maintenance and repair projects has been cited by Congress for several years. Moreover, a 2010 report from the National Research Council cited a "steady and significant decrease in NASA's laboratory capabilities, including equipment, maintenance, and facility upgrades" that require more maintenance than funding permits.

[3] GAO: "NASA Procurement: Use of Award Fees for Achieving Program Outcomes Should Be Improved" (GAO-07-58, January 17, 2007).

[4] NASA Annual Performance Metrics Report.

NASA's 2008 Authorization Act directed the Administrator to "determine and prioritize the maintenance and upgrade backlog at each of NASA's Centers and associated facilities, and . . . develop a strategy and budget plan to reduce that maintenance and upgrade backlog by 50 percent over the next five years." However, according to Agency officials funding constraints over the years have resulted in little reduction in NASA's backlog of deferred maintenance projects. Similarly, the recently enacted 2010 Authorization Act requires NASA to examine its structure, organization, and institutional assets and develop a strategy for the most efficient retention, sizing, and distribution of facilities and other infrastructure consistent with NASA's mission. Compiling such a report is difficult enough, but even more daunting is obtaining the funds necessary to repair and maintain NASA's key aging facilities or building a consensus on which facilities and infrastructure the Agency can no longer afford to support.

The OIG is currently evaluating NASA's efforts to effectively select and fund maintenance projects to reduce its deferred maintenance backlog. Specifically, we are examining whether NASA Centers appropriately communicated funding priorities and needs in the budget process and accurately captured costs associated with maintenance and repair activities in a consistent manner. In addition, the OIG recently initiated a second facilities-related audit evaluating NASA's response to requirements in the 2010 Authorization Act to re-scope and, as appropriate, downsize NASA's facilities footprint.

The ongoing challenge for NASA leadership in this area is to reduce the backlog of essential maintenance projects. Failure to do so will further increase the risk that Agency facilities will not be available for future use or will pose additional risks to the safety of personnel and equipment and the accomplishment of NASA's missions. Moreover, continuing to "kick the can down the road" by failing to take action to renovate essential facilities will result in higher costs to repair these facilities in the future.

Enhanced Use Leasing. As discussed previously, NASA has an excess of real property and faces considerable challenges addressing the maintenance needs of its aging facilities. Enhanced Use Leasing (EUL) offers the Agency one tool to help address this challenge. EUL authority allows agencies to retain proceeds from leasing out underutilized real property to private sector and other non-Federal governmental entities and to accept in-kind consideration in lieu of cash for rent.

Congress granted NASA limited EUL authority in FY 2003 and at that time NASA began demonstration programs at Ames Research Center and Kennedy Space Center. The GAO reviewed NASA's use of EULs in 2007 and found the Agency was using EUL authority to develop underutilized office space, unique research and development facilities, and land.[5] As reported for FY 2009, NASA had realized about $3.4 million in net revenue and over $530,000 of in-kind consideration, most of which would not have been realized without EUL authority.

A leasing study prepared by NASA in 2009 in response to a congressional directive highlighted several challenges the Agency faces in expanding its use of EUL authority. For example, NASA must ensure that the methodology it uses for determining leasing costs are consistent with normal real estate practices and that lease rates are fair and reasonable. The study also noted that the

[5] GAO: "NASA: Enhanced Use Leasing Program Needs Additional Controls" (GAO-07-306R, March 1, 2007).

costs of NASA's unique facilities and capabilities are embedded in NASA's overall real property costs and therefore the cost of leasing a NASA site is generally more expensive than the cost of private sector facilities. In addition, the costs associated with repairing NASA's aging facilities may be an obstacle to attracting potential tenants.

NASA will need to address these and other challenges in order to use its EUL authority to its full potential. EULs offer NASA the incentive to more fully utilize its facilities, which could help reduce the overhead costs associated with operating NASA Centers. Revenue from EULs also could be used by NASA to reduce the costs of maintaining its aging infrastructure.

4. Human Capital

The impending retirement of the Space Shuttle and NASA's redirection from the Constellation Program to support for development of commercial space flight capabilities present the Agency with the significant challenge of balancing its workforce structure with the needs of its shifting missions. As NASA reassesses its acquisition and workforce transition plan, the OIG will continue to monitor the Agency's progress in addressing these changing human capital challenges.

Attracting and Retaining a Highly Skilled Workforce. Maintaining a highly skilled, diverse, results-oriented civilian and contractor workforce is vital to successfully accomplishing NASA's mission. As the Agency's mission changes, NASA faces increasing competition from the private sector for the best scientific and engineering talent. Moreover, as its workforce ages NASA will face particular challenges in attracting and retaining highly specialized skill sets to sustain key Agency capabilities.

With regard to its future workforce, NASA plays a leading role in the Federal Government's efforts to inspire interest in science, technology, engineering, and mathematics (STEM). Through its Summer of Innovation Program, NASA seeks to engage students in NASA's mission and strengthen the Nation's future workforce through intensive summer teaching and learning experiences. NASA also sponsors competitions like the "Environmentally Responsible (Green) Aviation High School Student Challenge," which invites students to propose ideas and designs for future aircraft that use less fuel, produce less harmful emissions, and make less noise, and offers internships and fellowships in a wide variety of disciplines for both high school and college students. NASA will need to continue to use these and other innovative means to help meet its future workforce needs.

Future of the Astronaut Corps. Identifying the proper role and size of NASA's Astronaut Corps in a post-Space Shuttle environment presents special challenges to Agency leaders. Since its inception in 1959, the Astronaut Corps has been an integral part of the NASA mission and over the years the Agency's astronauts have adapted to a variety of new roles and missions. The cancellation of the Constellation Program and the increased reliance on the private sector to provide transportation to and from space raises new questions for the future of NASA's Astronaut Corps. NASA has taken an important step to address this management challenge by enlisting the National Research Council to conduct an independent study examining the role and size of the Astronaut Corps following the Shuttle's retirement.

In addition to recent changes in NASA's mission and direction, a series of long-standing challenges remain in this area. For example, NASA must ensure that astronauts maintain medical eligibility for missions as they age and increase their accumulated radiation exposure. Further, NASA has not fully identified how the Astronaut Corps in a post-Space Shuttle world will retain the skills necessary to perform the ISS mission with limited flight opportunities following the Shuttle's retirement in 2011.

Ensuring that Agency Employees Comply with Ethical Responsibilities. NASA employees routinely work side-by-side with contractors, international partners, and researchers from academia. Many NASA employees also seek opportunities in the private sector following their Government employment and others move between jobs in the private sector and NASA. These conditions pose particular challenges to NASA leadership to ensure that employees abide by ethics laws and regulations. Moreover, as NASA moves more deeply toward privatization of space exploration, this challenge may increase in both scope and complexity.

Ethics issues continue to account for a significant portion of the OIG's investigative caseload. For example, in a recent case a senior NASA manager was convicted of a conflict of interest charge in connection with his participation in NASA contracts given to a company owned by his wife. Another senior NASA manager used a majority of the $1.5 million discretionary fund he controlled to initiate several studies that financially benefited him and others. Further, a high-ranking NASA official was convicted of steering a $10 million contract to a consulting client and later entered a guilty plea to conspiracy charges in connection with actions he took to obtain and receive funds from a sole-source contract.

It is imperative that NASA employees, as stewards of the Agency's budget, remain aware of and comply with appropriate ethics laws and regulations. The OIG will continue to work with Agency officials to address potential ethics issues through a combination of training and enforcement.

5. Information Technology Security

NASA information technology (IT) systems and networks control spacecraft, collect and process scientific data, and enable NASA personnel to collaborate with their colleagues around the world. Users of these systems number in the hundreds of thousands and include NASA personnel, contractors, academia, and the public. As computer technology has advanced, NASA has become dependent on computerized information systems to carry out daily operations and to process, maintain, and report essential information. Although most NASA IT systems contain data that may be widely shared, others house sensitive information which, if released or stolen, could result in significant financial loss or adversely affect national security. Accordingly, it is imperative that NASA properly protect its IT systems and networks.

Role of the Chief Information Officer. Achieving the Agency's IT security goals will require sustained improvements in NASA's overarching IT management practices. Federal law and NASA policy designate the Headquarters-based Chief Information Officer (CIO) as the NASA official responsible for developing IT security policies and procedures and implementing an Agency-wide IT security program. However, we have found that the CIO has limited ability to

direct NASA's Mission Directorates to fully implement IT security programs, and consequently key Agency computer networks and systems operated by the Mission Directorates do not consistently comply with Agency-wide IT policy. Until the Mission Directorates fully implement NASA's IT security programs, the Agency will continue to be at risk for security incidents that can have a severe adverse effect on Agency operations, assets, or individuals.

IT Security Weaknesses. While the Agency reduced the severity of IT security from a material weakness to a significant deficiency in 2008 for purposes of the Administrator's Annual Statement of Assurance**,** recent audit work by the OIG found that significant obstacles remain in NASA's effort to develop a highly effective IT security program.

As part of our FY 2009 and FY 2010 Federal Information Security Management Act (FISMA) audits, we found that NASA's IT security program had not fully implemented key requirements needed to adequately secure Agency information systems and data. For example, NASA did not meet FISMA requirements for annual security controls testing and contingency plan testing. In our judgment, these deficiencies occurred because NASA did not have an independent verification and validation function for its IT security program.

We also found that the Office of the Chief Information Officer (OCIO) had not effectively managed corrective action plans used to prioritize mitigation of IT security weaknesses. This occurred because the OCIO did not have a formal policy for managing the plans and did not follow recognized best practices when it purchased an information system intended to facilitate Agency-wide management of IT corrective action plans. We found that the information system was significantly underutilized and therefore was not an effective tool for managing corrective action plans.

Through our audits and assessments during the past year, the OIG has found significant and recurring internal control weaknesses in NASA's IT security control monitoring and cyber-security oversight. For example, we found that the Agency did not ensure that its computer servers remained securely configured over time. We also found that the Agency's vulnerability and patch management practices could be improved by adding a control to verify that 100 percent of the devices connected to NASA's networks undergo vulnerability and patch monitoring. We found control weaknesses related to user account management, the installation of unauthorized software, and inaccuracies with hardware and software inventories for a key NASA system. Finally, we found that the Agency's transition from Internet Protocol Version 4 (IPv4) to IPv6 needed substantial improvement.

Attacks on IT Infrastructure. The significance of NASA's IT security weaknesses is highlighted by the increasing number of cybersecurity threats facing the Agency. These threats are evolving, both in scope and sophistication, and present an ongoing challenge to NASA managers. For example, in May 2009 NASA notified the OIG of a suspicious computer connection from a system that supports NASA missions. The subsequent OIG investigation confirmed that cybercriminals had infected a computer system that supports one of NASA's mission networks. Due to the inadequate security configurations on the system, the infection caused the computer system to make over 3,000 unauthorized connections to domestic and international IP addresses including, but not limited to, addresses in China, the Netherlands,

Saudi Arabia, and Estonia. The sophistication of the attack confirms that this event was a focused and sustained effort to target NASA's data.

The OIG also alerted NASA to systemic IT deficiencies discovered during the course of an investigation into unlawful computer intrusions at the Jet Propulsion Laboratory (JPL). The OIG determined that the intrusions resulted in the theft of approximately 22 gigabytes of program data illegally transferred to an IP address in China. The stolen data included information protected under International Traffic in Arms Regulations and Export Administration Regulations. The OIG investigation found that a significant contributing factor to the theft was inadequate security settings at JPL, which allowed the intruder access to a wide range of sensitive data. NASA's challenge is to redouble its efforts to improve IT security to decrease the likelihood of similar incidents in the future even as the threat expands and the sophistication of the cyber attacks increases.

6. Financial Management

After receiving disclaimers of opinion on its financial statements during the previous 7 years, this year NASA was able to develop sufficient financial evidence and documentation to allow auditors to issue a qualified opinion on the Agency's FY 2010 financial statements. The qualification was related to the valuation of property, plant, and equipment (PP&E) and materials in prior years and its possible effects on the current year statements of net cost and changes in net position. Over the past several years, NASA financial managers – working with the OIG and the independent accounting firm – have continued to make steady progress resolving previously identified weaknesses and their efforts resulted in the auditors' qualified opinion. While the ultimate goal for the Agency is an unqualified opinion, the FY 2010 results are a significant accomplishment and position NASA well for the future.

During FY 2010, NASA continued to develop policies, procedures, and controls to address its internal control deficiencies. For example, NASA revised its policy and procedures for quantifying its environmental cleanup costs associated with decommissioning PP&E. Nevertheless, challenges remain. Specifically, NASA management and Ernst & Young LLP continue to identify deficiencies in the Agency's system of internal control surrounding contractor-held legacy PP&E. As shown in the following table, this deficiency was reported as a material weakness for several years.

Internal Control Deficiencies						
Fiscal Year		2010	2009	2008	2007	2006
Audit Opinion		Qualified	Disclaimer	Disclaimer	Disclaimer	Disclaimer
Internal Control Deficiencies	Property, Plant, and Equipment	significant deficiency	material weakness	material weakness	material weakness	material weakness
	Financial Statement Preparation Process and Oversight	—	—	material weakness	material weakness	material weakness
	Environmental Liability Estimation*	significant deficiency	significant deficiency	—	—	—
	Federal Financial Management Improvement Act*	—	significant deficiency	—	—	—
* The deficiency was included in the Financial Statement Preparation Process and Oversight weakness for FYs 2006–2008.						

Property, Plant, and Equipment. NASA has struggled with asserting to the completeness and valuation of its legacy assets, the largest of which is the ISS. However, in October 2009 the Federal Accounting Standards Advisory Board issued an accounting standard clarifying that reasonable estimates of historical cost may be used to value general PP&E.[6] Consequently, NASA's challenge was to use this standard to value its legacy assets to resolve one of the key obstacles to obtaining an opinion in FY 2010.

In implementing this new standard, NASA considered using different sources to estimate historical capitalized amounts, such as appraisals and budget estimates, as alternatives to its historical approach of using contractor cost reports and capitalized amounts recorded in its Contractor-Held Asset Tracking System (CHATS).[7] For the ISS, NASA determined that the CHATS figures provided the more precise estimate and therefore it would continue to use these figures to estimate the historical cost of the ISS.

However, while conducting routine analysis, NASA discovered an unexpected $1.1 billion adjustment by a contractor in CHATS for materials that are considered depreciable property for the ISS. Upon further investigation, NASA determined that approximately $470 million of this adjustment was the result of the contractor failing to report an increase when the underlying transaction occurred and that the remainder was a "double count" having previously been reported by the contractor. NASA appropriately never recorded this double count. Nevertheless, this discovery calls into question the rigor and effectiveness of the controls surrounding contractor reporting in CHATS and indicates that NASA needs to further develop its controls in this area.

[6] Statement of Federal Financial Accounting Standard (SFFAS) No. 35, *Estimating the Historical Cost of General Property, Plant, and Equipment (Amending Statements of Federal Financial Accounting Standards 6 and 23*).

[7] CHATS is a Web-based application that contractors use to report to NASA summarized values of Government-owned materials and property in its possession.

Going forward, NASA needs to focus on fully implementing its PP&E capitalization policy and procedures for assets procured on or after October 1, 2007. For example, during FY 2010 testing the auditors identified two instances where completed and fully acquired assets were also recorded in the work-in-process account. As a result, the auditors could not conclude that NASA's controls in this area were operating effectively and had to expand their testing.

In addition to valuing legacy assets, NASA also must account for materials related to those assets, most of which are contractor-held. In light of the Space Shuttle's scheduled retirement, NASA considered whether any of the materials included in its reported balances were excess or obsolete to NASA. NASA determined that its current method for accounting for these materials did not reflect NASA's research and development mission and that a large majority of these materials would have no value by the end of the current fiscal year due to the Shuttle's retirement. Therefore, NASA adopted a change in accounting principle that permitted the removal of the entire $2.7 billion materials asset line item from its balance sheet.

Prior to FY 2010, NASA did not capitalize property reported in year-end CHATS or other annual contractor reports because it had not analyzed the data prior to November 15 of each year. Instead, NASA recorded an accrual to estimate the value of contractor-held property as of September 30. As part of the preparation of the FY 2010 financial statements, NASA performed its analysis prior to November 15 for the first time and this analysis resulted in the Agency recording a $661 million adjustment to contractor-held property. The size of the adjustment calls into question the sufficiency and basis of the methodology used to calculate these estimates.

Due to the volatility of NASA's property balances and the risk of recording estimates for property, accounting for PP&E remains a significant management challenge. Ongoing efforts by NASA management to develop a robust and rigorous review process that both validates and challenges the adequacy of estimation techniques and the sufficiency of supporting documentation are important in preparing for future audits of these estimates. The volatility and risk associated with these balances are expected to decline as legacy contracts conclude.

Improper Payments Information Act (IPIA) Assessment

Improper Payment Compliance

NASA is dedicated to reducing fraud, waste, and abuse by adequately reviewing and reporting programs susceptible to improper payments in accordance with the Office of Management and Budget (OMB) Circular A-123, Management's Responsibility for Internal Control, Appendix C, Requirements for Effective Measurement and Remediation of Improper Payments. To improve the integrity of the Federal government's payments and the efficiency of its programs and activities, Congress enacted the Improper Payments Information Act (IPIA) of 2002 (Public Law No. 107-300). The IPIA contains requirements in the areas of improper payment identification and reporting. It requires agency heads to annually review all programs and activities, identify those that may be susceptible to significant improper payments, estimate annual improper payments in susceptible programs and activities, and report the results of their improper payment activities.

In August 2006, OMB issued Appendix C of OMB Circular A-123. Appendix C supersedes OMB's previous promulgations on improper payments and requires all Executive branch agencies to:

- Review all of its programs and activities to identify those susceptible to significant improper payments. OMB defines significant improper payments as those in any particular program or activity that exceed both 2.5 percent of program payments and $10 million annually;
- Obtain a statistically valid estimate of the annual amount of improper payments in programs and activities;
- Develop corrective action plans and reduction targets for programs and activities found to have significant improper payments; and
- Include an estimate of the annual amount of improper payments in programs and activities, along with the progress in reducing them, in the PAR.

The term "payment "is defined by the Office of Management and Budget (OMB) Circular A-123 Appendix C guidance as any payment, including commitments for future payments, such as loan guarantee that is derived from Federal funds or other Federal sources; ultimately reimbursed from Federal funds or resources; or made by a Federal agency, a Federal contractor, a governmental or other organization administering a Federal program or activity.

Additionally, NASA took into consideration the increased emphasis on reducing improper payments as outlined in Executive Order (EO) 13520 Reducing Improper Payments and Eliminating Waste in Federal Programs issued by President Barack Obama on November 23, 2009. EO 13520 intensifies efforts to eliminate payment error, waste, fraud and abuse in major programs administered by the Federal government, requires increased focus on identifying and eliminating the highest number of improper payments and assigns accountability, and encourages partnership and collaboration among Federal, state and local governments. The EO adopts a comprehensive set of policies, including transparency and public scrutiny of significant payment errors. Also, on July 22, 2010, the President signed into law the Improper Payments Elimination and Recovery Act of 2010 (IPERA), which mandates the recoupment of improper and erroneous payment dollars by recovery audits targeting all types of programs and activities including grants. IPERA urges departments and agencies to use all available tools and technologies to address improper payments and intensifies the reporting requirements on the results and methods used.

Throughout the past four years, NASA has diligently met IPIA program compliance by launching OMB-compliant risk assessments, updating NASA payment process documentation, selecting OMB-compliant statistical samples for testing, drafting comprehensive test procedures, reporting results in the annual PAR and documenting the IPIA review process and results in comprehensive work papers.

During FY 2010, NASA continued its efforts to improve the integrity of its payments and the efficiency of its programs by updating the annual risk assessment. The updated risk assessment identified 33 programs in scope and covered $18.4 billion in FY 2009 disbursements. Once the programs were evaluated, NASA identified the following five programs as susceptible to improper payments:

- **Constellation Systems**
- **Cosmic Origins**
- **Earth Science Research**
- **Earth Systematic Missions**
- **Space Communications**

Total payments related to these programs amounted to approximately $3,631,633,701 in FY 2009. During FY 2010, with the assistance of contractor support, NASA performed an improper payment review of each of these programs in accordance with OMB Circular A-123, Appendix C and identified an estimated total of approximately $7,698,973 in improper payments. This annual estimate was based on NASA's FY 2009 payment transaction data (October 1, 2008 through September 30, 2009). Although the testing performed determined that the programs did not have significant improper payments, as defined by OMB A-123, Appendix C, NASA will continue to monitor payments and take appropriate corrective action for any such improper payments.

Improper Payments Information Act Reporting Details

To conduct the FY 2010 IPIA assessment, NASA adhered to the established improper payment methodology, considered lessons learned from past IPIA assessments, and the NASA Risk Assessment methodology. In order to satisfy the IPIA requirements the following tasks and activities were executed:

- **Updated the FY 2009 risk assessment;**
- **Selected a statically valid sample of payments;**
- **Conducted a test of all transactions selected in the sample and extrapolated the results to make a valid estimate; and**
- **Reported on the details of testing and findings (if any) of the program**

In the following section we summarize the details of the FY 2010 IPIA program.

I. Risk Assessment

NASA's risk assessment methodology was developed using criteria established for determining levels of risk and evaluating all major programs against these criteria. Risk factors included conditions related to financial processing and internal controls, internal and external monitoring and assessments, human capital risk, programmatic risk, and the nature of programs and payments.

In FY 2010, NASA performed a comprehensive qualitative and quantitative update to its existing FY 2009 risk assessment to identify programs susceptible to high risk of significant improper payments. NASA's risk assessment methodology is illustrated in Figure 1 below, along with a brief summary of steps and results.

Figure 1: NASA's Risk Assessment Methodology and Results

Determine Scope	Identify Programs Eligible for Assessment FY 2009	Analyze Risk Conditions	Prepare Risk Assessment
•Identified 84 distinct programs •Estimated maximum error rate of program disbursements at 12.5% •Materiality level of programs in scope set at $80M •The programs in scope covered $18.4 B in FY 2009 disbursements	•Identified 33 programs within assessment scope •Identified 8 programs that received ARRA funds •Non programmatic disbursements such as Institutions and Management also included under FY 2010 assessment scope	•Evaluated FY 2009 Audit Reports, Findings and Recommendations •Evaluated Financial Management trends in Internal Controls •Evaluated risk conditions including control environment, human capital risk and nature of payments.	•Updated Information based on intelligence gathered from NASA Financial Management Products and independent reviews •Populated Risk Assessment matrix with initial feedback. •Identified 5 programs susceptible to improper payments based on risk ratings.

(1) Determine Scope

To determine the scope of programs subject to the Risk Assessment, NASA prepared an initial selection based on the FY 2009 total disbursements; identifying 84 distinct programs. NASA generated and provided the disbursement totals for each program from its financial management system. The aggregate disbursement total was validated against NASA's SF-133, Report on Budget Execution and Budgetary Resources.

(2) Identify Programs Eligible for FY 2010 Assessment

A review of the 84 distinct programs was made to determine whether or not they meet the materiality thresholds for review. The materiality of disbursements is derived from an estimated error rate of 12.5 percent of program disbursements. Using this estimate, the materiality level of programs in scope was set at $80 million. The number of programs in scope was reduced to 33 based on the materiality of disbursements. NASA also developed a questionnaire of additional risk conditions that NASA's programs were evaluated against. The questionnaires were completed by Senior Management and selected Program personnel and captured data such as risk assessment scores, disbursement values, and estimated error rates.

(3) Analyze Risk Condition

The control environment, internal and external monitoring, human capital risk, programmatic risk, and nature of program payment risk factors were analyzed during the risk assessment. NASA also reviewed documents, including the Review of Open Audit Recommendations Affecting Recovery Act Activities (Report Number. IG-10-014: Assignment No. A-09-009-01) and the Government Accountability Office (GAO) report Improper Payments: Weaknesses in USAID's [U.S. Agency for International Development's] and NASA's Implementation of the Improper Payments Information Act and Recovery Auditing (GAO-08-77, November 9, 2007). NASA completed all work necessary to close the four open recommendations in the GAO report in FY 2010 and GAO indicated to NASA that the recommendations are closed. Among other documents, NASA also examined the report on NASA's Overall Assessment of Internal Control over Financial Reporting. Once this review and analysis was complete, the FY 2010 Risk Assessment was updated to reflect the NASA programs found to be susceptible to improper payments.

(4) Prepare Risk Assessment

The programs identified during FY 2010 are: Institutions and Management, International Space Station Mars Exploration, Space Shuttle Program, Constellation Systems, Earth Science Research, Earth Systematic Missions, Cosmic Origins and Space Communications. Together, these programs represent approximately 90 percent of the FY 2009 disbursements. Table 1 below provides the FY 2010 programs susceptible to improper payments. A score greater than 3.00 is deemed "high risk" per the NASA Risk Assessment Methodology.

Table 1: NASA Programs Identified as Susceptible to Improper Payments with respective risk rating

Program	Determined Risk After Testing in FY 2007	Determined Risk After Testing in FY 2008	Determined Risk After Testing in FY 2009	2010 Risk Assessment Rating	Selected for Testing FY 2010
Institutions and Management	Low	Low	Low	3.68	No
International Space Station	Low	Low	Low	3.41	No
Mars Exploration	Low	Low	Low	3.88	No
Space Shuttle Program	Low	Low	Low	3.20	No
Constellation Systems	N/A	Low	Low	3.68	Yes
Earth Science Research	N/A	Low	Low	3.74	Yes
Earth Systematic Missions	N/A	N/A	Low	3.98	Yes
Cosmic Origins	N/A	N/A	Low	4.16	Yes
Space Communications	N/A	N/A	N/A	3.01	Yes (New Program)

As shown in Table 1, based on testing results from previous years (FY 2007 to FY 2009), some programs initially identified during the FY 2010 risk assessment were deemed low risk as a result of the testing performed during the past 3 years and testing was not required during FY 2010. The following programs that received high risk ratings in FY 2010 but were actually tested and evaluated and were deemed to be actually low risk and do not require testing again in FY 2010 are:

- **Institutions and Management**
- **International Space Station**
- **Mars Exploration**
- **Space Shuttle Program**

Therefore, the following programs that were rated high risk were selected for the FY 2010 testing phase:

- **Constellation Systems**
- **Cosmic Origins**
- **Earth Science Research**
- **Earth Systematic Missions**
- **Space Communications**

Statistical Sampling Process

For each program selected for testing, NASA developed a statistically valid random sample of program payments, in accordance with OMB guidelines. NASA constructed a stratified, random sample to yield an estimate with a 90 percent confidence level with a margin of error of plus or minus 2.5 percent for each program. The sample was drawn from the universe of disbursements that occurred from October 1, 2008 through September 30, 2009. For each selected program undergoing an improper payment review, NASA developed samples for the following payment types: vendor payments; government purchase card transactions; and travel expenditures. A total number of 1,517 transactions were selected. Figure 2 below illustrates the overall sample design by total disbursements by program for FY 2010.

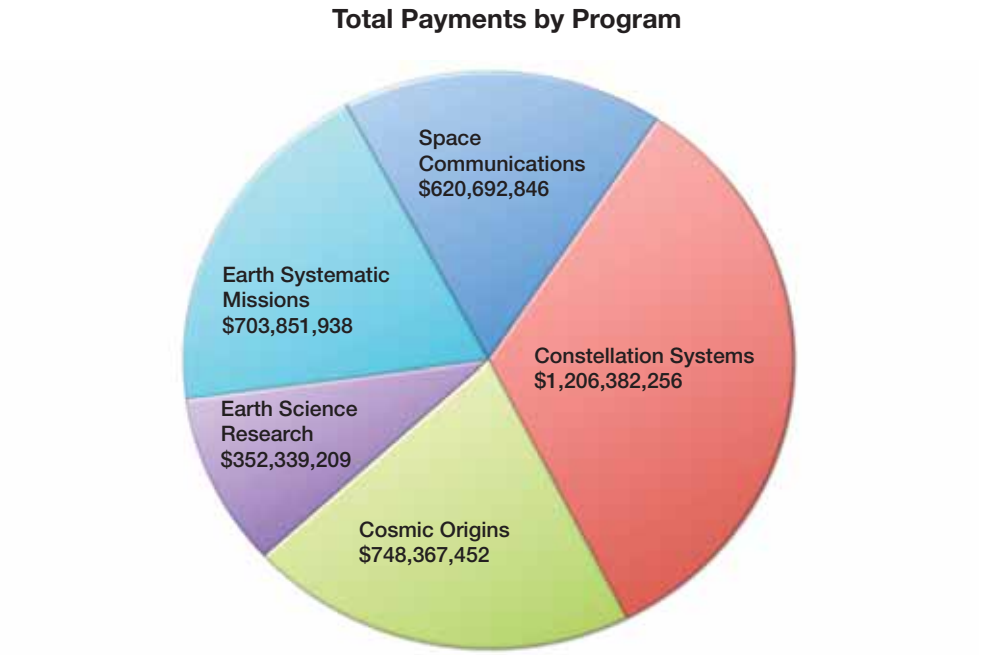


Figure 2: Sample Design by total disbursements by program for FY 2010

Description of Population and Sample Data

A random sample was selected for each of the five programs identified as susceptible to high risk of significant improper payments. Table 2 shows the number of transactions and dollar value by program for the payment population and sample.

Table 2: Transaction and dollar value by program and payment type (Population and Sample)

Program	Contracts		Travel		Purchase Cards	
	Population	Sample	Population	Sample	Population	Sample
Constellation Systems						
Transactions	34,821	368	24,855	8	23,232	5
Dollar Amount	$1,184,585,743	$368,399,761	$14,141,866	$10,500	$7,654,647	$2,390
Cosmic Origins						
Transactions	6,545	220	3,253	4	24,591	4
Dollar Amount	$742,842,581.00	$400,600,435.99	$2,862,326.21	$8,410.71	$2,662,544.95	$8,568.98
Earth Science Research						
Transactions	9,012	355	2,718	9	19,218	9
Dollar Amount	$347,630,350.00	$74,966,767.11	$2,309,848.24	$26,242.93	$2,399,010.95	$1,968.10
Earth Systematic Missions						
Transactions	9,493	306	4,584	5	18,849	4
Dollar Amount	$697,362,189.00	$294,791,060.70	$3,555,131.38	$6,226.27	$2,934,617.14	$10,852.25
Space Communications						
Transactions	4,792	217	1,986	2	3,372	1
Dollar Amount	$618,507,198.00	$352,867,063.10	$1,541,136.05	$1,940.84	$644,512.17	$210.94
Transaction Totals		**1466**		**28**		**23**

Conclusion

In total, NASA identified two (2) improper contract payments. The total payments are identified in Table 3 below:

Table 3: Improper payments by NASA program

Finding - Unauthorized Commitment		
Program	**Improper Payment Amount Over (Under)**	**# of Payments**
Earth Science Research	$29,159.84	1
Cosmic Origins	$7,167.00	1
Total	**$36,326.84**	**2**

As illustrated below, an extrapolation of the two payments over the entire universe resulted in $7,698,973 of estimated improper payments with an estimate percentage of 0.21% during the period October 1, 2008 through September 30, 2009. Both the improper payment percentage and the estimated amount of improper payments are not considered significant as defined by OMB A-123, Appendix C. Consequently, NASA is not required to submit a written corrective action plan; however, NASA will implement corrective actions in FY 2011 to further reduce its exposure to improper payments. Table 4 below shows the total payments by population, sample amount, and annual estimate of improper payments by program.

Table 4: Total Payments by Population, sample amount and annual estimate of improper payments by program

	Transactions		Dollars		FY 2010 Percentage Estimate of Improper Payments	FY 2010 Annual Estimate of Improper Payments
	Population	Sample	Population	Sample		
Constellation Systems	82,908	381	$1,206,382,256	$368,412,651	0.00%	$0
Cosmic Origins	34,389	228	748,367,452	400,617,416	0.53%	3,959,348
Earth Science Research	30,948	373	352,339,209	74,994,978	1.06%	3,739,625
Earth Systematic Missions	32,926	315	703,851,938	294,808,139	0.00%	0.00
Space Communications	10,150	220	620,692,846	352,869,215	0.00%	0.00
Totals	**191,321**	**1,517**	**$3,631,633,701**	**$1,491,702,399**	**0.21%**	**$7,698,973**

Recovery Audit

In accordance with the requirements of section 831 of the Defense Authorization Act of FY 2002, NASA performs recovery audits as part of its overall program of effective internal control over contract payments. In FY 2010 NASA performed a recovery audit focused on its FY 2008 disbursements.

In accordance with OMB guidance, agencies may determine to exclude classes of contracts and contract payments from recovery audit activities if the agency head determines that the recovery audits are inappropriate or not a cost-effective method for identifying and recovering improper payments. Consequently NASA does not include cost-type contracts in its assessment for recovery audits.

NASA engages an industry leader in recovery auditing under a contingency contract and the firm audited FY 2006 and FY 2007 disbursements in prior years. This year, FY 2008 disbursements were audited and the results are listed in the table below. The Recovery Audit of FY 2009 disbursements is underway.

Agency Component	Amount Subject to Review for FY 2008 Reporting	Actual Amount Reviewed and Reported FY 2008	Amounts Identified for Recovery FY 2008	Amounts Recovered FY 2008	Amounts Identified for Recovery Prior Years (PYs)	Amounts Recovered (PYs)	Cumulative Amounts Identified for Recovery (CY+ PYs)	Cumulative Amounts Recovered (CY + PYs)
NASA	$4,985,006,667	$4,985,006,667	$24,824	$9,728	$209,552	$206,281	$234,376	$216,009

The Agency has taken steps through the Improper Payment reviews and recovery audits to continue holding Agency managers accountable for reducing and recovering improper payments. The Recovery Audit process is monitored by headquarters to ensure compliance with NASA's Recovery Audit Guidance. In addition, all collection and disbursement functions are now centralized at the NASA Shared Services Center which ensures not only prompt recovery of overpayments, but an effective way to control and review all contract payments.

NASA has the infrastructure and information technology in place to reduce improper payments. There are no statutory or regulatory barriers limiting NASA's ability to reduce improper payments.

FY 2010 Inspector General Act Amendments Report

Background

The Inspector General Act Amendments of 1988 (P.L. 100-504), require that the head of each federal agency submit semi-annual reports to Congress on the actions taken in response to Office of Inspector (OIG) audit, evaluation, and inspection reports. Under the authority of the Reports Consolidation Act of 2000 (P.L. 106-531), the National Aeronautics and Space Administration (NASA) consolidates and annualizes the required semi-annual Inspector General Act Amendments reporting elements for inclusion in the annual Performance and Accountability Report (PAR).

Required agency reporting under the 1988 amendments includes:

1. Disclosure of OIG reports containing findings with monetary benefits (i.e., disallowed costs and funds put to better use):

- on which management decisions were made during the reporting period;
- for which final management decisions have been made, but final management action is pending;
- for which final management action was taken during the reporting period, and;
- for which no final management action was taken during the reporting period.

2. Disclosure of OIG audit reports issued in prior fiscal years for which final management action is pending, but not yet completed.

In addition to above statutory requirements, the Office of Management and Budget (OMB) has issued specific action requirements to federal agencies in their Circular No. A-50, "Audit Follow-up." These requirements include among other things that federal agencies ensure that final management decisions on audit recommendations are reached within six months after an OIG audit report is issued and that related corrective action associated with the final management decision begin as soon as possible.

The following definitions are provided to enhance the readability of NASA's FY 2010 Inspector General Act Amendments Report:

Final Management Decision is reached when management evaluates the OIG's findings and recommendations and determines whether or not to implement a proposed recommendation.

Final Management Action is the point in time when corrective action, taken by management in conjunction with a final management decision, is completed.

Corrective Action consists of remediation efforts on the part of management which are intended to mitigate an audit finding.

Questioned Costs are those identified by the OIG as being potentially unallowable or unallocable because of (a) an alleged violation of a provision of a law, regulation, contract, grant, cooperative agreement, or other agreement or document governing the expenditure of funds; (b) a finding that, at the time of the audit, such cost is not supported by adequate documentation; or (c) a finding that the expenditure of funds for the intended purpose is unnecessary or unreasonable.

Disallowed Costs are questioned costs that management has sustained or agreed should not be charged to the Government.

Funds to be Put to Better Use (FPTBU) are funds that could be used more efficiently if management implemented an audit recommendation. Efficiencies may result from: reductions in outlays; de-obligation of funds, or; costs not incurred by implementing recommended improvements related to operations of the agency, a contractor, or a grantee.

NASA's Audit Follow-up Program

NASA management is committed to ensuring timely and responsive final management decisions along with timely and complete final management action on audit recommendations issued by external auditors including the OIG. NASA management believes that audit follow-up is essential to improving the efficiency and effectiveness of NASA's programs, projects, and operations. In this regard, NASA has implemented a comprehensive program of audit liaison, resolution, and follow-up intended to ensure that audit recommendations issued by the OIG and the Government Accountability Office (GAO) are resolved and implemented in a timely, responsive, and effective manner.

NASA has designated the Office of Internal Controls and Management Systems (OICMS) as the Agency's lead for policy formulation, oversight, and functional leadership of NASA's audit liaison, resolution and follow-up program. OICMS administers related program activities through an agency-wide network of Audit Liaison Representatives (ALRs) who are responsible for executing audit liaison, resolution, and follow-up program activities. This network of ALRs, in conjunction with OICMS oversight, provides the organizational structure to support NASA's audit liaison, resolution, and follow-up program. Program activities are tracked, monitored and reported through the utilization of NASA's Audit and Assurance Information Reporting System (AAIRS). AAIRS is a web-based tracking and reporting tool utilized by OICMS and NASA ALRs to monitor key activities and milestones associated with audits performed by the OIG and GAO.

In accordance with requirements delineated in OMB Circular A-50, OICMS monitors audit recommendations issued by the OIG to ensure that a final management decision is reached within six months of the issuance of a final audit report. A final management decision consists of either agreeing to implement an OIG recommendation; agreeing to implement a portion of an OIG recommendation, or; declining to implement an OIG recommendation. In those instances where agreement between the OIG and NASA management cannot be reached, a final management decision will be sought from NASA's Audit Follow-up Official (AFO).

Once a final management decision has been made to either implement or partially implement an OIG audit recommendation, corrective action on the part of management is pursued as rapidly as possible, in accordance with provisions of OMB Circular A-50. On occasion, the corrective action associated with a final management decision spans several fiscal years. This may be due to the complexity of the planned corrective action (which often times consists of the design, implementation, and testing of related systems or sub-systems); or the development, concurrence and review process associated with the issuance of NASA policy and/or procedural requirements. In spite of these constraints, NASA management continues to aggressively pursue the implementation of agreed-upon corrective action relating to audit recommendations issued by the OIG.

The Inspector General Act Amendments of 1988 require that heads of federal agencies report on actions taken, or remaining to be taken, in response to OIG audit reports containing monetary findings. The amendments also require that management disclose those OIG audit reports for which a final management decision had been made in a prior reporting period, but where final management action is still pending. In addition to the statutory reporting requirements delineated in the Inspector General Act Amendments of 1988, OMB Circular A-50, requires that final management decisions on OIG audit recommendations be made within six months of the issuance of a final audit report. NASA's reporting in conjunction with the requirements of the Inspector General Act Amendments of 1988 and OMB Circular A-50 follows:

FY 2010 Audit Follow-up Results

1. OIG Audit Reports with Monetary Findings

During FY 2010, the OIG issued an audit report containing one monetary finding with questioned costs in the amount of $23,000[1]. Subsequent to the OIG's identification of questioned costs, NASA management sustained a total of $23,059 in disallowed costs associated with contract payment calculation errors. Final management action taken in response to the $23,059 is disallowed costs consisted of recovering the full amount prior to the end of the current fiscal year.

[1]Review of NASA's Microgravity Flight Services (IG-10-015), dated June 18, 2010. OIG questioned costs in the amount of $23,000 were subsequently sustained as disallowed costs in the amount of $23,059.

The OIG issued one additional audit report containing a monetary finding consisting of $12,019[2] in questioned costs, however those questioned costs were not sustained as disallowed costs, consequently no recovery action on the part of management was required, nor was any taken.

There were no prior year OIG reports with monetary findings requiring final management action at the beginning of FY 2010. As a result of the final management action taken with respect the $23,059 noted above, there were no OIG reports with monetary findings pending final management decision or final management action at the end of FY 2010 (see Table 1).

Table 1: Summary of Disallowed Costs and Funds to Be Put to Better Use (For the Year Ended September 30, 2010)

Category	Disallowed Costs		Funds to be Put To Better Use	
	Number of Reports	Dollars	Number of Reports	Dollars
1. Reports pending final management action at the beginning of the reporting period	0	$0	0	$0
2. Plus: Reports on which management decisions were made during the reporting period	1	$23,059	0	$0
3. Total reports pending final action during the reporting period (1+2)	1	$23,059	0	$0
4. Reports on which final action was taken during the reporting period	1	$23,059	0	$0
5. Audit reports pending final action at the end of the reporting period (3-4)	0	$0	0	$0

2. Prior-Year OIG Reports Pending Completion of Final Management Action

As of September 30, 2010, there were 12 OIG audit reports issued in prior fiscal years containing a total of 34 recommendations on which a final management decision had been made, but final management action was still pending (see Table 2).

The nature of the final management action associated with the 34 open and outstanding audit recommendations can be broken down into four broad categories namely: (1) Internal Monitoring/Program Review for Compliance; (2) Development/Revision of Policy; (3) Development/Execution of Training Activities, and; (4) System Enhancements/ Updates.

By way of comparison, as of September 30, 2009, there were 18 OIG audit reports containing 38 recommendations on which final management decisions were made in prior years, but final management action was still pending. For the five year period ended September 30, 2010, the number of OIG audit recommendations pending final management action one year or more after issuance of a final audit report ranged between 34 and 53.

[2]Final Memorandum on the Review of NASA's Payment of Task Order 389 to United Launch Alliance (IG-10-010), dated June 1, 2010.

Table 2: Summary of OIG Audit Reports Pending Final Management Action One Year or More After Issuance of a Final Report (As of September 30, 2010)				
Report No.		**No. of Recommendations**		
Report Date	**Report Title / (Report Number)**	**Open**	**Closed**	**Total**
IG05016 05-12-05	NASA's Information Technology Vulnerability Assessment Program	1	3	4
IG06007 03-17-06	NASA's Implementation of Patch Management Software is Incomplete	1	1	2
IG07014 06-19-07	Controls Over the Detection, Response and Reporting of Network Security Incidents Needed Improvement at Four NASA Centers Reviewed	4	4	8
IG07029 09-18-07	Final Memorandum on Audit of Education and Training Grants	1	4	5
IG08004 12-11-07	Final Memorandum on NASA's Accounting for Real Property Leased to Other Entities	4	0	4
IG08005 12-11-07	Final Memorandum on NASA's Accounting for Capitalized Real Property Designated as Inactive	4	0	4
IG08025 9-19-08	(Redacted) Center's Security Program Needed Improvement	4	4	8
IG09003 11-13-08	Final Memorandum on the Review of NASA Stolen Property at Goddard Space Flight Center and Marshall Space Flight Center	1	4	5
IG09015 4-27-09	NASA's Process for Providing Personal Identity Verification (PIV) Cards Were Not Completely Effective in Meeting Federal Requirements	3	3	6
IG09018 7-14-09	Improvements Needed in NASA's Oversight and Monitoring of Small Business Contractor Transfers of Export-Controlled Technologies	3	1	4
IG09017 7-27-09	Opportunities to Improve the Management of the Space Flight Awareness Honoree Launch Conference Event	1	0	1
IG09022 9-25-09	NASA Should Reconsider The Award Evaluation Process And Contract Type For The Operation Of The Jet Propulsion Laboratory	7	1	8
12	**Totals**	**34**	**25**	**59**

3. Final Management Decisions Not Made Within Six Months of a Report Date

During FY 2010, the OIG issued a total of 22 audit reports containing 83 recommendations addressed to NASA. A final management decision on each of the 83 audit recommendations issued in FY 2010 was made within six months of the respective final report dates. As of September 30, 2010, there were no OIG audit recommendations for which a final management decision had not been made within six months of the final report date.

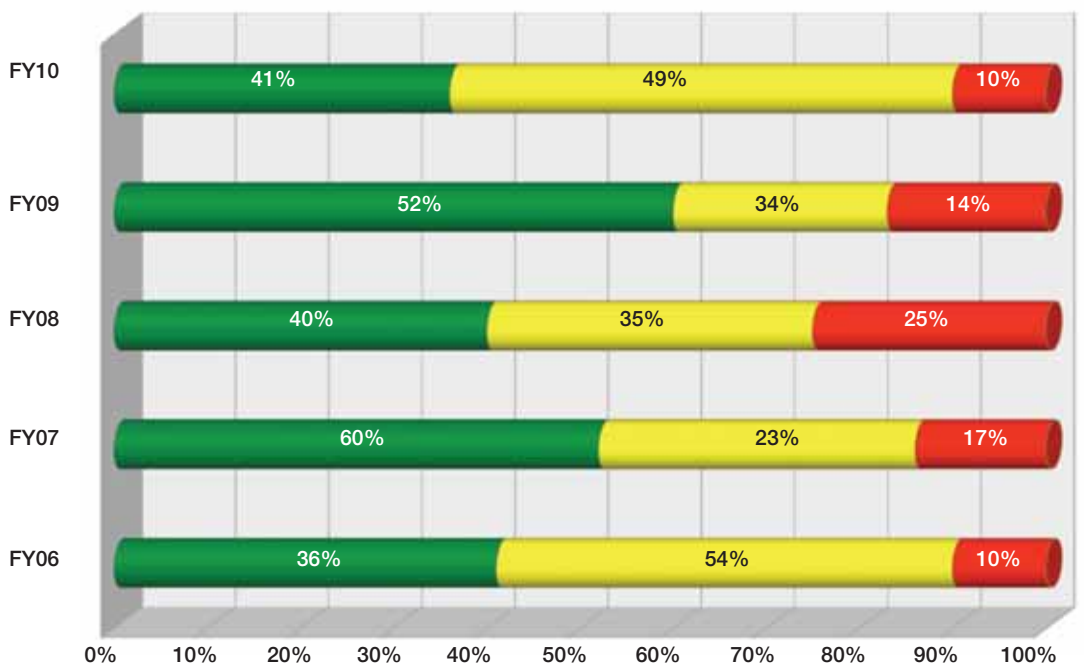
For comparative purposes, for the fiscal year ended September 30, 2009, NASA reported no outstanding final management decisions pending more than six month after the issuance of a final OIG audit report. Furthermore, for the five-year period ended September 30, 2010, no final management decision on any OIG audit recommendation was made more than six months after issuance of a final OIG audit report.

4. Audit Recommendation Closure Efficiency

During FY 2010, 76 OIG-issued audit recommendations, including 64 recommendations issued in prior fiscal years, were closed based on responsive final management action. Of the 76 recommendations closed in FY 2010, forty-one percent (31 recommendations) were closed within one year of the issuance of the associated audit report, while ninety percent (68 recommendations) were closed within two years of the issuance of the associated audit report.

In FY 2009, fifty-two percent (58 recommendations) of OIG audit recommendations were closed with one year of the issuance of the associated audit report, and eighty-six percent (96 recommendations) were closed within two years of the issuance of the associated audit report. For the five year period ended September 30, 2010, an average of 46 percent of OIG-issued audit recommendations were closed within one year of the final issuance of the associated audit report, while an average of 85 percent of OIG-issued audit recommendations were closed within two years of the issuance of the associated audit report (see Table 3).

Table 3: Closure Efficiency: OIG Recommendations FY 2006–FY 2010



	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
< 1 year after report	36%	60%	40%	52%	41%
> 1 year < 2 years after report	54%	23%	35%	34%	49%
> 2 years after report	10%	17%	25%	14%	10%

As previously noted, NASA's completion of corrective action in response to OIG audit recommendations is contingent upon a variety of factors including the complexity of the planned corrective actions and available resources. Despite these constraints, NASA management is committed to the improvement of Agency activities as identified by the OIG in their audit reports and associated recommendations.

Summary of Financial Statement Audit and Management Assurances

The following tables summarize the Agency's FY 2010 Financial Statement Audit and Management Assurances. Table 1 summarizes the status of the FY 2009 prior year material weaknesses identified by the Financial Statement Auditor. Table 2 summarizes the status of the FY 2009 prior year material weaknesses identified by NASA Management.

Table 1: Summary of Financial Statement Audit

Audit Opinion	Qualified				
Restatement	Yes				
Material Weaknesses	**Beginning Balance**	**New**	**Resolved**	**Consolidated**	**Ending Balance**
Controls Over Legacy Property, Plant, and Equipment	1	0	1	0	0
Total Material Weaknesses	**1**	**0**	**1**	**0**	**0**

Table 2: Summary of Management Assurances

Effectiveness of Internal Control Over Financial Reporting (FMFIA 2)						
Statement of Assurance	Unqualified					
Material Weaknesses	**Beginning Balance**	**New**	**Resolved**	**Consolidated**	**Reassessed**	**Ending Balance**
Controls Over Legacy Property, Plant, and Equipment	1	0	1	0	0	0
Total Material Weaknesses	**1**	**0**	**1**	**0**	**0**	**0**
Effectiveness of Internal Control Over Operations (FMFIA 2)						
Statement of Assurance	Unqualified					
Material Weaknesses	**Beginning Balance**	**New**	**Resolved**	**Consolidated**	**Reassessed**	**Ending Balance**
None	0	0	0	0	0	0
Total Material Weaknesses	**0**	**0**	**0**	**0**	**0**	**0**
Conformance With Financial Management Systems Requirements (FMFIA 4)						
Statement of Assurance	Systems Conform					
Non-Conformances	**Beginning Balance**	**New**	**Resolved**	**Consolidated**	**Reassessed**	**Ending Balance**
Total Non-Conformances	**0**	**0**	**0**	**0**	**0**	**0**
Compliance With Federal Financial Management Improvement Act (FFMIA)						
Overall Substantial Compliance 1. System Requirements met? 2. Accounting Standards met? 3. USSGL at Transaction Level met?	Agency Yes			 Yes Yes Yes	Auditor Yes	

Federal Financial Management Systems Strategy

During the past decade NASA strategically modernized its integrated financial management system. The strategy led to a re-engineered financial management system infrastructure using industry "best practices" that deploys enabling technology to provide management information on a real time basis. NASA has integrated the core financial system with procurement, human capital, travel, and asset management, for improved reporting and analysis. The core financial system accounting platform includes, the Standard General Ledger, Accounts Receivable, Accounts Payable, Purchasing, Cost Management, Materials Management, Facilities Maintenance and Asset Accounting. The NASA Enterprise Applications Competency Center (NEACC) provides centralized operations.

NASA's core financial system supports its budget formulation, execution, and funds control, consistent with the requirements of OMB Circular A-11, Preparation, Submission, and Execution of the Budget. NASA consistently provides timely and reliable budget and other financial reports for management throughout the agency, using information generated from its financial system. Agency executives and operating managers rely on this budget and financial information for decision making.

NASA's core financial system is supported by ancillary feeder systems with common data elements that adhere to government-wide standards for reporting. A comprehensive set of internal controls are in place to maintain integrity and reliability of the information generated by the system. NASA's independent audit of the FY 2010 financial statements has found no material weaknesses or misstatements.

NASA's internal control compliance framework, the Comprehensive Compliance Strategy (CCS), serves as the basis for ensuring effective agency-wide financial management, financial reporting, and financial control. It encompasses guiding principles for executing effective financial management functions and activities with internal control and compliance solutions inherently embedded in the process. Monitoring and oversight of the effectiveness of the CCS is conducted through the Continuous Monitoring Program (CMP) as well as through ongoing Evaluation Monitoring and Testing (EMT) periodic compliance reviews. The EMT reviews provide another level of management assurance regarding compliance with CCS, while at the same time serving as a review program used to periodically measure the effectiveness of CMP and validate the operating effectiveness of internal controls over financial reporting.

In fiscal year 2010, NASA's comprehensive set of internal controls safeguarded its assets from loss, misappropriation, or destruction. Internal control activities are monitored monthly for operating effectiveness. Identified deficiencies are corrected timely and, existing controls are strengthened as necessary. As a result, there are no known instances of asset loss, misappropriation, or destruction attributable to the financial system. NASA's integrated financial management system is in substantial compliance with Federal Financial Management Information Act (FFMIA) requirements.

NASA FY 2010 Public Law 111-117 Undisbursed Balances in Expired Grant Accounts

NASA monitors and tracks grants undisbursed balances in expired accounts through a monthly review of internal control activities designed to identify undisbursed balances in expired accounts. The Continuous Monitoring Program (CMP) ensures ongoing review and validation of financial data and the effectiveness of internal controls over the entire financial management process, including grants. When grants undisbursed balances in expired accounts are identified, appropriate action is taken to ensure optimum use of grant resources.

NASA generates financial management reports to aid in the tracking and monitoring of undisbursed amounts. An aging report of open obligations is generated on a monthly basis to determine the last day activity occurred. For open obligations in which no activity has occurred in a six month period and/or there is no supporting documentation, further review is performed to determine the validity of obligation balances and the existence of valid source documentation. Additionally, further analysis is performed to determine if funds can be de-obligated. If obligations are valid, the aging reports are updated to reflect that obligations have been confirmed with procurement as valid.

NASA will continue to track undisbursed balances in expired grant accounts through its monthly review of internal control activities designed to identify funds for de-obligation. This involves the continuous monitoring of undisbursed balances, identifying balances that should be de-obligated, and performing timely close-out of grants and other activities. Additionally, NASA's financial management and procurement offices will continue to collaborate in monitoring and tracking undisbursed balances.

Currently, NASA does not have undisbursed balances in expired accounts that may be returned to the Treasury of the United States. The following chart reflects the total number and dollar amount of undisbursed grants in expired appropriations. All amounts have been obligated to a specific project.

Year	Total Number of Expired Grants	Total Amount of Expired Grants (In Millions of Dollars)
2007	4,462	$175
2008	2,077	$124
2009	2,105	$58

Missions at a Glance

Aeronomy of Ice in the Mesosphere (AIM) is a two-year mission to study Polar Mesospheric Clouds (PMCs), Earth's highest clouds, which form an icy membrane 50 miles above Earth's surface at the edge of space. The primary goal of AIM is to explain why PMCs form and what causes changes in their behavior. *http://www.nasa.gov/mission_pages/aim/index.html*

Aqua is a major international Earth Science satellite mission. Launched on May 4, 2002, the satellite has six different Earth-observing instruments on board and is named for the mission's focus on water in the Earth system. Aqua collects approximately 89 gigabytes of data daily. *http://www.nasa.gov/mission_pages/aqua/index.html*

Aquarius is a focused satellite mission that measures global sea surface salinity. After its launch in 2011, it will provide a global view of salinity variability to enhance climate studies. NASA and the Space Agency of Argentina are currently developing Aquarius. *http://aquarius.gsfc.nasa.gov/*

Ares 1 is an in-line, two-stage rocket. Ares I was designed to launch Orion, the Crew Exploration Vehicle, into low Earth orbit for missions to the ISS and other destinations as part of the Constellation Program. *http://www.nasa.gov/mission_pages/constellation/ares/aresl/index.html*

Aura was launched July 15, 2004. The Aura satellite studies Earth's ozone, air quality, and climate. *http://www.nasa.gov/mission_pages/aura/main/index.html*

Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) uses a cloud profiling radar system to study the role that clouds and airborne particles play in regulating Earth's weather, climate, and air quality. CALIPSO combines an active lidar instrument with passive infrared and visible imagers to probe the structure and properties of thin clouds and aerosols over the globe. NASA launched CALIPSO on April 28, 2006 with the CloudSat satellite. *http://www.nasa.gov/mission_pages/calipso/main/index.html*

Cassini/Huygens was launched on a Titan IV rocket in October 1997, carrying NASA's Cassini orbiter and the European Space Agency's Huygens probe. The Cassini/Huygens mission is providing data for a detailed study of Saturn, its rings, icy satellites, magnetosphere, and the environment of Titan. *http://saturn.jpl.nasa.gov/index.cfm*

Chandrayaan-1 was an Indian Space Research Organization (ISRO) mission to study the Moon, launched on October 22, 2008. It was an international mission, with payloads from Europe as well as the United States. NASA's contribution included the Moon Mineralogy Mapper (M3) instrument, designed to look for lunar mineral resources. Despite loss of contact only a year into its planned two-year mission, Chandrayaan-1 played a key role in the groundbreaking 2009 discovery of water molecules on the Moon. *http://www.isro.org/chandrayaan/htmls/home.htm*

Chandra X-ray Observatory, launched and deployed by Space Shuttle *Columbia* on July 23, 1999, is the most sophisticated X-ray observatory built to date. Since Earth's atmosphere absorbs the vast majority of X-rays, they are not detectable from Earth-based telescopes. Chandra is advancing knowledge about the high-energy universe. *http://science.nasa.gov/missions/chandra/*

Coupled Ion Neutral Dynamics Investigation (CINDI), launched on April 16, 2008, studies the elements that influence space weather near Earth's equator. *http://www.nasa.gov/mission_pages/cindi/*

Climate Absolute Radiance and Refractivity Observatory (CLARREO) is a climate-focused mission, currently planned to launch in 2017. Measurements derived from CLARREO will be used to detect climate trends and to test, validate, and improve climate prediction models. *http://clarreo.larc.nasa.gov/*

The **Constellation Program** was intended to create a new generation of spacecraft for human spaceflight, consisting primarily of the Ares I and Ares V launch vehicles, the Orion crew capsule, the Earth Departure Stage, and the Altair Lunar Lander. *http://www.nasa.gov/mission_pages/constellation/main/index.html*

The **Deformation, Ecosystem Structure, and Dynamics of Ice (DESDynI)** mission's objectives are to: determine the likelihood of earthquakes, volcanic eruptions, and landslides; predict the response of ice sheets to climate change and impact on the sea level; characterize the effects of changing climate and land use on species habitats and carbon budget; and monitor the migration of fluids associated with hydrocarbon production and groundwater resources. DESDynI is currently planned to launch in 2017. *http://desdyni.jpl.nasa.gov/*

Earth Observing-1 (EO-1) developed and validated a number of instrument and spacecraft bus breakthrough technologies designed to enable the development of future earth imaging observatories. EO-1 was launched on November 21, 2000. http://eo1.gsfc.nasa.gov/

EPOXI combines two exciting science investigations in a new mission that re-uses the Deep Impact spacecraft already in orbit around the Sun. The Extrasolar Planet Observation and Characterization (EPOCh) investigation observed stars with giant planets, and the Deep Impact eXtended Investigation (DIXI) of comets observed comet 103P/Hartley 2 during a close flyby in November 2010. *http://www.nasa.gov/mission_pages/epoxi/index.html*

The **Fermi Gamma-ray Space Telescope** explores the most extreme environments in the universe. The mission is a partnership between NASA, the U.S. Department of Energy, and institutions in France, Germany, Japan, Italy and Sweden. Fermi was launched June 11, 2008. *http://fermi.gsfc.nasa.gov/*

Glory is a low Earth orbit scientific research spacecraft that will collect data on Earth's atmosphere and climate system to determine if temperature increase and climate change are natural events or the effects of human influence. *http://glory.gsfc.nasa.gov/*

Geostationary Operational Environmental Satellite (GOES)/Polar Operational Environmental Satellite (POES) is composed of two geostationary satellites and two polar orbiting satellites that operate in pairs to monitor the east and west coasts separately. They provide real-time weather data for short-term weather forecasting of severe weather, space environment monitoring, and research and development. The polar orbiting satellites provide global long-range weather forecasting, ensuring that non-visible data are no more than six hours old. *http://goespoes.gsfc.nasa.gov/goes/index.html*

The Global Hawk campaigns are the first Earth Science missions to be conducted using a Global Hawk unmanned aircraft system. Ten specialized instruments were installed in the aircraft to explore the trace gases, aerosols, and dynamics of the upper troposphere and lower stratosphere. The Pacific campaign is the first of its scientific missions. *http://www.nasa.gov/centers/dryden/research/GloPac/index.html*

Global Precipitation Measurement (GPM) is one of the next generation of satellite-based Earth science missions that will study global precipitation such as rain, snow, and ice. *http://science.nasa.gov/missions/gpm/*

Gravity Recovery and Climate Experiment (GRACE) accurately maps variations in Earth's gravity field. GRACE launched on March 17, 2002, sending two identical spacecraft into a polar orbit about 310 miles above the Earth. *http://science.nasa.gov/missions/grace/*

Gravity Recovery and Interior Laboratory (GRAIL) is a duel satellite mission with high-quality gravity mapping capabilities that will be launched to the Moon to determine the structure of the lunar interior, from crust to core, and to advance understanding of the Moon's thermal evolution. *http://science.nasa.gov/missions/grail/*

Herschel is a European Space Agency mission, with participation from ten countries, including the United States. The Herschel Space Observatory is a space-based telescope that will study the universe by the light of the

far-infrared and submillimeter portions of the spectrum. Herschel was launched on May 14, 2009. *http://www.nasa.gov/mission_pages/herschel/index.html*

Hinode (Solar-B) is a Japanese mission developed, launched and operated by Institute for Space and Astronautical Science/Japan Aerospace Exploration Agency (ISAS/JAXA), in partnership with NASA and other entities. Its mission is to measure solar magnetic fields. Hinode was launched on September 22, 2006. *http://www.nasa.gov/mission_pages/hinode/index.html*

Hubble Space Telescope, launched on April 1990, is a large, space-based observatory which has revolutionized astronomy by providing unprecedented deep and clear views of the universe, ranging from the solar system to extremely remote fledgling galaxies that began forming not long after the Big Bang 13.7 billion years ago. *http://hubble.nasa.gov/*

Interstellar Boundary Explorer (IBEX), launched October 19, 2008, is a small satellite, about the size of a bus tire. IBEX is the first mission designed to map the entire region of the boundary of the Solar System while circling the Earth. *http://science.nasa.gov/missions/ibex/*

IceBridge, a six-year NASA mission, is the largest airborne survey of Earth's polar ice ever flown. Data collected during IceBridge will help scientists bridge the gap in polar observations between NASA's Ice, Cloud and Land Elevation Satellite (ICESat-I)—in orbit since 2003—and ICESat-2, planned for late 2015. *http://www.nasa.gov/mission_pages/icebridge/mission/index.html*

Ice, Cloud, and Land Elevation Satellite (ICESat)-1, launched in February 2004, is the benchmark Earth Observing System mission for measuring ice sheet mass balance, cloud and aerosol heights, as well as land topography and vegetation characteristics. ICESat I has provided multi-year elevation data needed to determine ice sheet mass balance as well as cloud property information, especially for stratospheric clouds common over polar areas. ICESat stopped collecting science data in 2009, and it will be replaced by ICESat II, currently in formulation. *http://icesat.gsfc.nasa.gov/icesat/*

Ice, Cloud, and Land Elevation Satellite (ICESat)-2 is the second generation of the orbiting laser altimeter ICESat, scheduled for launch in late 2015. *http://icesat.gsfc.nasa.gov/icesat2/*

The **International Space Station (ISS)** was begun in 1998 and will be completed by 2011. Scientists will continue daily research operations in its microgravity environment that spans several sciences, enhancing knowledge in the fields of biology, human biology, physics, astronomy, and meteorology. It is also a testbed for space exploration technologies and capabilities. *http://www.nasa.gov/mission_pages/station/main/index.html*

Jason-1, launched on December 7, 2001, is an oceanography mission to monitor global ocean circulation, improve global climate predictions, and monitor events such as El Niño conditions and ocean eddies. *http://sealevel.jpl.nasa.gov/*

Jason-2/Ocean Surface Topography Mission (OSTM), which launched June 20, 2008, follow the ocean surface topography measurements of TOPEX/Poseidon (T/P) and the Jason-1 mission, and extends the time series of observations to two decades. *http://sealevel.jpl.nasa.gov/missions/ostmjason2/*

Juno will significantly improve understanding of the formation, evolution, and structure of Jupiter. It will answer critical science questions about Jupiter, as well as provide key information to dramatically enhance present theories about the early formation of the solar system. *http://science.nasa.gov/missions/juno/*

The **James Webb Space Telescope (JWST)** is a large, infrared-optimized space telescope that will find the first galaxies that formed in the early universe. It will peer through dusty clouds to see stars forming planetary systems. *http://science.nasa.gov/missions/jwst/*

Kepler, launched on March 6, 2009, is surveying the local region of the Milky Way galaxy to discover hundreds of Earth-size and smaller planets in or near the habitable zone and determine the fraction of the hundreds of billions of stars in the galaxy that might have such planets. *http://www.nasa.gov/mission_pages/kepler/main/index.html*

Lunar CRater Observation and Sensing Satellite (LCROSS) launched with LRO on June 18, 2009. The main LCROSS mission objective is to confirm the presence or absence of water ice in a permanently shadowed crater near a lunar polar region. *http://www.nasa.gov/lcross/*

The **Landsat Data Continuity Mission (LDCM)** follows the Landsat mission and provides continuous satellite acquisition of high-resolution multispectral data of Earth's surface on a global basis. LDCM is a collaboration between NASA and the U.S. Geological Survey. The data from the Landsat spacecraft constitute the longest record of the Earth's continental surfaces as seen from space, unmatched in quality, detail, coverage, and value. *http://ldcm.nasa.gov/*

The **Lunar Reconnaissance Orbiter (LRO)** mission objectives are to find safe landing sites on the Moon, locate potential resources, characterize the radiation environment, and demonstrate new technology. LRO was launched on June 18, 2009, along with LCROSS. *http://www.nasa.gov/mission_pages/LRO/main/index.html*

The **Mars Exploration Rovers, "Spirit"** and **"Opportunity**," were launched on June 10 and July 7, 2003. Primary among the mission's scientific goals is to search for and characterize a wide range of rocks and soils that hold clues to past water activity on Mars. *http://www.nasa.gov/mission_pages/mer/index.html*

Mars Express is a European Space Agency mission designed as a low-cost, fast-track effort. Countries involved include France, Germany, Great Britain, Ireland, Italy, the Netherlands, Norway, Russia, Sweden, Spain, Japan, and the United States. Mars Express launched June 2, 2003. The seven instruments on the orbiter are currently making observations at Mars. *http://marsprogram.jpl.nasa.gov/express/*

Mars Odyssey is mapping the mineralogy and morphology of the Martian surface. *http://mars.jpl.nasa.gov/odyssey/index.cfm*

The **Mars Atmosphere and Volatile EvolutioN (MAVEN)** mission will provide the first direct measurements ever taken to address key scientific questions about Mars' evolution. Mars once had a denser atmosphere that supported the presence of liquid water on the surface. As part of a dramatic climate change, most of the Martian atmosphere was lost. MAVEN will make definitive scientific measurements of present-day atmospheric loss that will offer clues about the planet's history. *http://www.nasa.gov/mission_pages/maven/main/index.html*

Magnetospheric Multiscale (MMS) is a Solar-Terrestrial Probe mission that will be comprised of four identically instrumented spacecraft. It will use Earth's magnetosphere as a laboratory to study the microphysics of three fundamental plasma processes: magnetic reconnection, energetic particle acceleration, and turbulence. *http://science.nasa.gov/missions/mms/*

The **Mars Reconnaissance Orbiter (MRO)**, launched August 12, 2005, is searching for evidence that water persist on the surface of Mars. *http://science.nasa.gov/missions/mars-reconnaissance-orbiter/*

The **Mars Science Laboratory (MSL)** is a large, roving laboratory that will collect and analyze dozens of soil and rock samples while exploring the planet with greater range than any previous Mars rover. As planned, the robotic laboratory will carry the most advanced payload of scientific gear ever used on Mars' surface, a payload more than 10 times as massive as payloads on earlier Mars rovers. *http://science.nasa.gov/missions/msl/*

Nuclear Spectroscopic Telescope Array (NuSTAR) will search for black holes, map supernova explosions, and study the most extreme active galaxies. *http://www.nustar.caltech.edu/*

The **Orbiting Carbon Observatory (OCO)-2** is based on the original OCO mission that failed to reach orbit in 2009 and is designed to enable more reliable predictions of climate change. *http://oco.jpl.nasa.gov/index.cfm*

Orion, also known as the Crew Exploration Vehicle, was NASA's next-generation spacecraft for human spaceflight. Orion had three main components—the crew module (capsule), service module/spacecraft adapter, and launch abort system. *http://www.nasa.gov/mission_pages/constellation/orion/index.html*

The **Radiation Belt Storm Probes (RBSP)** mission will explore the Sun's influence on the Earth and near-Earth space by studying the planet's radiation belts. The two spacecraft will measure the particles, magnetic and electric

fields, and waves that fill geospace and provide new knowledge on the dynamics and extremes of the radiation belts. *http://rbsp.jhuapl.edu/*

The **Solar Dynamics Observatory (SDO)** is designed to help understand the Sun's influence on Earth and near-Earth space by studying the solar atmosphere. SDO launched on February 11, 2010. *http://www.nasa.gov/mission_pages/sdo/main/index.html*

The **Soil Moisture Active-Passive (SMAP)** mission will use a combined radiometer and high-resolution radar to measure Earth's surface soil moisture and freeze-thaw state. Direct measurements of soil moisture and freeze/thaw state are needed to improve understanding of regional water cycles, ecosystem productivity, and processes that link the water, energy, and carbon cycles. *http://science.nasa.gov/missions/smap/*

Solar and Heliospheric Observatory (SOHO), launched on December 2, 1995, is a project of international collaboration between European Space Agency and NASA to study the Sun from its deep core to the outer corona and the solar wind. *http://www.nasa.gov/mission_pages/soho/index.html*

Solar Probe Plus will come closer to the Sun than any spacecraft has ever flown. This mission will study the streams of charged particles the Sun hurls into space from inside the Sun's corona - its outer atmosphere - where the processes that heat the corona and produce solar wind occur. *http://solarprobe.jhuapl.edu/index.php*

The **Space Shuttle** is the most complex machine ever built and its capacity is instrumental in building the International Space Station. *http://www.nasa.gov/mission_pages/shuttle/main/index.html*

Spitzer Space Telescope launched August 25, 2003. Spitzer obtained images and spectra by detecting the infrared energy, or heat, radiated by objects in space. Most of this infrared radiation is blocked by Earth's atmosphere and cannot be observed from the ground. *http://www.nasa.gov/mission_pages/spitzer*

Solar Terrestrial Relations Observatory (STEREO), launched in October 2006, is providing a unique and revolutionary view of the Sun–Earth system. The two observatories, one ahead of Earth in its orbit, the other trailing behind, trace the flow of energy and matter from the Sun to Earth. *http://www.nasa.gov/mission_pages/stereo/main/index.html*

The **Stratospheric Observatory for Infrared Astronomy (SOFIA)** is an airborne observatory that will complement the Hubble, Spitzer, Herschel and James Webb space telescopes, as well as major Earth-based telescopes. SOFIA is a joint program by NASA and DLR Deutsches Zentrum fur Luft- und Raumfahrt (German Aerospace Center). *http://www.nasa.gov/mission_pages/SOFIA/index.html*

Terra is a multi-national, multi-disciplinary partnership mission between the U.S., Canada and Japan. On February 24, 2000, Terra began collecting what will ultimately become a new, 15-year global data set on which to base scientific investigations of Earth. Terra carries five state-of-the-art sensors that have been studying the interactions among the Earth's atmosphere, lands, oceans, and radiant energy. *http://www.nasa.gov/mission_pages/terra/index.html*

The **Tracking and Data Relay Satellite (TDRS)** is the communication satellite component of the Tracking and Data Relay Satellite System, which provides tracking and data acquisition services between low Earth orbiting spacecraft and control and/or data-processing facilities. The system is capable of transmitting to and receiving data from spacecraft over at least 85 percent of the spacecraft's orbit. The first TDRS was launched in 1983 on the Space Shuttle *Challenger*'s first flight, STS-6. *http://nssdc.gsfc.nasa.gov/multi/tdrs.html*

Time History of Events and Macroscale Interactions during Substorms (THEMIS), launched in February 2007, aims to resolve one of the oldest mysteries in space physics: to determine what physical process in near-Earth space initiates the violent eruptions of the aurora that occur during sub-storms in Earth's magnetosphere. *http://www.nasa.gov/mission_pages/themis/mission/index.html*

The **Tropical Rainfall Mapping Mission (TRMM)** is a joint mission between NASA and the Japan Aerospace Exploration Agency (JAXA) to monitor and study tropical rainfall. The satellite was launched on November 27, 1997 from the Tanegashima Space Center in Tanegashima, Japan. *http://trmm.gsfc.nasa.gov/*

The **Voyager 1** and **2** spacecraft continue exploring in their 33rd year after their 1977 launches. They each are much farther away from Earth and the Sun than Pluto. Voyager 1 and 2 are now in the "Heliosheath"—the outermost layer of the heliosphere where the solar wind is slowed by the pressure of interstellar gas. Both spacecraft are still sending scientific information about their surroundings through the Deep Space Network (DSN). *http://www.nasa.gov/mission_pages/voyager/index.html*

The **Wide-field Infrared Survey Explorer (WISE)** will scan the entire sky in infrared light. Among the objects WISE will study are asteroids, the coolest and dimmest stars, and the most luminous galaxies. WISE launched on December 14, 2009. *http://www.nasa.gov/mission_pages/WISE/main/index.html*

Wilkinson Microwave Anistropy Probe (WMAP) is a NASA Explorer mission that launched June 2001 to make fundamental measurements of cosmology, the study of the properties of the universe as a whole. WMAP has been stunningly successful, producing a new Standard Model of Cosmology. WMAP continues to collect high-quality scientific data. *http://science.nasa.gov/missions/wmap/*

The **X-48B** is an advanced concept, fuel-efficient blended wing body aircraft. Boeing Phantom Works' advanced research and development unit has partnered with NASA and the U.S. Air Force Research Laboratory (AFRL) at Wright Patterson Air Force Base, Ohio, to explore and confirm the structural, aerodynamic and operational advantages of the blended wing body design. *http://www.nasa.gov/vision/earth/improvingflight/x48b.html*

Acronyms

AAIRS	Audit and Assurance Information Reporting System
AIRS	Atmospheric Infrared Sounder
ACAT	Automatic Collision Avoidance Technology
ACM	Attitude Control Monitor
AFO	Audit Follow-up Official
AICPA	American Institute of Certified Public Accountants
AIM	Aeronomy of Ice in the Mesosphere
AIRS	Atmospheric Infrared Sounder
ALHAT	Autonomous Landing and Hazard Avoidance Technology
ALIP	Annular Linear Induction Pump
ALR	Audit Liaison Representatives
AMS	Alpha Magnetic Spectrometer
AMSRE	Advanced Microwave Scanning Radiometer Earth Observing system
AO	Announcement of Opportunity
APG	Annual Performance Goal
ARC	Ames Research Center
ARMD	Aeronautics Research Mission Directorate
ARRA	American Recovery and Reinvestment Act
ASC	Accounting Standards Codification
ASP	Airspace Systems Program
AT	Aeronautics Technology
ATP	Aeronautics Test Program
AUC	Assets Under Construction
AvSP	Aviation Safety Program
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations
CAPP	Constellation Assessment of Personal Property
CAS	Cross Agency Support
CCD	Charge-Coupled Device
CCDev	Commercial Crew Development
CCF	Capillary Channel Flow
CDR	Critical Design Review
CEV	Crew Exploration Vehicle

CFD	Computational Fluid Dynamics
CHS	Crew Health and Safety
CINDI	Coupled Ion Neutral Dynamics Investigation
CME	Coronal Mass Ejection
CMP	Continuous Monitoring Program
C/NOFS	Communication/Navigation Outage Forecast System
COTS	Commercial Orbital Transportation Services
CPIAC	Chemical Propulsion Information Analysis Center
CRO	Cumulative Results of Operations
CSRS	Civil Service Retirement System
DFRC	Dryden Flight Research Center
DM	Deferred Maintenance
DM2	Development Motor
DOD	Department of Defense
DOE	Department of Energy
DPMC	Directorate Program Management Council
DSIP	Dynamic Selection of Interface Patterns
ECR	Environmental Compliance and Restoration
EEO	Equal Employment Opportunity
EF	Exposed Facility
ELV	Expendable Launch Vehicle
EMA	Electromechanical Actuators
ENAs	Energetic Neutral Atoms
EO	Equal Opportunity
ERBIS	Engineering Review Board Information System
ERIC	Exploration Requirements for Institutional Capabilities
EOS	Earth Observing System
EOY	End of Year
ESMD	Exploration Systems Mission Directorate
ESSP	Earth System Science Pathfinder
ESTP	Earth Science Technology Program
ET	External Tank
ETDP	Exploration Technology Development Program
EUV	Extreme Ultraviolet
EVA	Extravehicular Activity
EXPRESS	Expedite the Processing of Experiments to the Space Station
FAA	Federal Aviation Administration
FAP	Fundamental Aeronautics Program
FAR	Federal Acquisition Regulation
FASAB	Federal Accounting Standards Advisory
FASB	Financial Accounting Standards Board
FBWT	Fund Balance with Treasury

FCI	Facility Condition Index
FECA	Federal Employees' Compensation Act
FEHB	Federal Employee Health Benefits
FEGLI	Federal Employees Group Life Insurance
FERS	Federal Employees Retirement System
FFMIA	Federal Financial Management Improvement Act of 1996
FPTBU	Funds to be Put to Better Use
FY	Fiscal Year
GAAP	Generally accepted accounting principles
GAO	Government Accountability Office
GC	Gas Chromatograph
GDGPS	Global Differential Global Positioning System
GeV	Giga-electronvolt
GOES	Geostationary Operational Environmental Satellite
GPM	Global Precipitation Measurement
GPRA	Governmental Performance and Results Act
GRACE	Gravity Recovery and Climate Experiment
GRAIL	Gravity Recovery and Interior Laboratory
GSFC	Goddard Space Flight Center
HQ	NASA Headquarters
HRP	Human Research Program
IBEX	Interstellar Boundary Explorer
ICC	Integrated Cargo Carrier
ICESat	Ice, Cloud, and Land Elevation Satellite
InSAR	Interferometric Synthetic Aperture Radar
IP	Intellectual Property
IPIA	Improper Payments Information Act
IPCC	Intergovernmental Panel on Climate Change
IPO	Integrated Program Office
IPERA	Improper Payments Elimination and Recovery Act of 2010
IOC	Initial Operation Capability
ISRP	Integrated Systems Research Program
ISS	International Space Station
IVGEN	IntraVenous Fluid GENeration
IVHM	Integrated Vehicle Health Management
JAXA	Japanese Aerospace Exploration Agency
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Flight Center
JWST	James Webb Space Telescope
KDP	Key Decision Point
KSC	Kennedy Space Center
LAFS	Lunar Analog Feasibility Study

LAPS	Lunar Analog Pilot Study
LaRC	Langley Research Center
LAT	Large Area Telescope
LCC	Launch Control Center
LCC	Lifecycle Cost
LCROSS	Lunar Crater Observing and Sensing Satellite
LDCM	Landsat Data Continuity Mission
LHB	Late Heavy Bombardment
LIS	Land Information System
LLCD	Lunar Laser Communication Demonstration
LOLA	Lunar Orbiter Laser Altimeter
LQP	Lunar Quest Program
LRO	Lunar Reconnaissance Orbiter
LSAH	Lifetime Surveillance of Astronaut Health
LRR	Launch Readiness Review
LSCR	Lunar Surface Concept Review
LSP	Launch Services Program
LWS	Living With a Star
M3	Moon Mineralogy Mapper
MARCbot	Multifunction Agile Remote Control Robot
MARES	Muscle Atrophy Research and Exercise System
MAVEN	Mars Atmosphere and Volatile EvolutioN
MCCS	Mission Control Center System
MDAO	Multidisciplinary design, analysis, and optimization
MELFI	Minus Eighty-Degree Laboratory Freezer for ISS
MERRA	Modern Era Retrospective Analysis for Research Applications
MICAST	Magnetically Controlled Convective Conditions
MISR	Multiangle Imaging SpectroRadiometer
mJy	Millijansky
MLLP	MidLevel Leader Program
MMS	Magnetospheric Multiscale
MODIS	Moderate Resolution Imaging Spectroradiometer
MOR	Missions Operations Review
MPLM	Multipurpose Logistics Module
MRO	Mars Reconnaissance Orbiter
MSFC	Marshall Space Flight Center
MSL	Mars Science Laboratory
MUST	Motivating Undergraduates in Science and Technology
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NextGen	Next Generation Air Transportation System
NEWS	NASA Energy and Water cycle Study

NLS	NASA Launch Services
NPAT	National Partnership for Aeronautical Testing
NOAA	National Oceanic and Atmospheric Administration
NRA	NASA Research Announcement
NRC	National Research Council
NRPTA	National Rocket Propulsion Test Alliance
NTRs	New Technology Reports
NTTS	National Technology Transfer System
NWS	National Weather Service
OCO	Orbiting Carbon Observatory
OE	Office of Education
OIG	Office of Inspector General
OMB	Office of Management and Budget
OMI	Ozone Monitoring Instrument
OM&S	Operating Materials and Supplies
ORR	Operation Readiness Review
OSI	Office of Strategic Infrastructure
PAR	Performance and Accountability Report
PDR	Preliminary Design Review
PID	Parameter Identification
PIV	Personal Identity Verification
P.L.	Public Law
PMM	Permanent Multipurpose Module
POES	Polar Operational Environmental Satellite
PP&E	Property Plant and Equipment
QuickSCAT	Quick Scatterometer
R&D	Research and Development
RBSP	Radiation Belt Storm Probes
RHESSI	Ramaty High Energy Solar Spectroscopic Imager
RPT	Rocket Propulsion Test
RSRM	Reusable Solid Rocket Motor
RSS	Rotating Service Structure
RTF	Return to Flight
SAA	Space Act Agreement
SAM	Sample Analysis at Mars
SBC	Single Board Computer
SBIR	Small Business Innovative Research
SDO	Solar Dynamics Observatory
SCaN	Space Communications and Navigation
SDO	Solar Dynamics Observatory
SEP	Solar Energetic Particle
SFFAS	Statement of Federal Financial Accounting Standard

SFW	Supersonic Fixed Wing
SGL	Standard General Ledger
SGSS	Space Network Ground Segment Sustainment
SID	Strategic Investments Division
SIR	Systems Integration Review
SMAP	Soil Moisture ActivePassive
SMD	Science Mission Directorate
SMS	Safety and Mission Success
SOC	Security Operations Center
SOFIA	Stratospheric Observatory for Infrared Astronomy
SOHO	Solar and Heliospheric Observatory
SOMD	Space Operations Mission Directorate
SpaceX	Space Exploration Technologies Corporation
SPoRT	Short-term Prediction Research and Transition
SRR	System Requirements Review
SS	Space Shuttle
SSME	Space Shuttle Main Engine
STEM	Science, Technology, Engineering, and Mathematics
STEREO	Solar Terrestrial Relations Observatory
STTR	Small Business Technology Transfer
SUP	Supersonics Project
TBCC	Turbinebased Combined Cycle
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TOGW	Takeoff Gross Weight
TRL	Technology Readiness Level
TRMM	Tropical Rainfall Mapping Mission
USAID	U.S. Agency for International Development
USGS	U.S. Geological Survey
VAAC	Volcanic Ash Advisory Center
VCAM	Vehicle Cabin Atmosphere Monitor
VLD	Vertical Light Deployment
WFO	Weather Forecast Office
WISE	Widefield Infrared Survey Explorer
WMAP	Wilkinson Microwave Anistropy Probe
WORF	Window Observational Research Facility
WRF	Weather and Research Forecast
WRP	Wide Range Pump

Center Information

NASA Headquarters (HQ)
Washington, DC 20546-0001
(202) 358-0000
www.nasa.gov/centers/hq/home/index.html

NASA Ames Research Center (ARC)
Moffett Field, CA 94035-1000
(650) 604-5000
www.nasa.gov/centers/ames/home/index.html

NASA Dryden Flight Research Center (DFRC)
P.O. Box 273
Edwards, CA 93523-0273
(661) 276-3311
www.nasa.gov/centers/dryden/home/index.html

NASA John H. Glenn Research Center at Lewis Field (GRC)
21000 Brookpark Road
Cleveland, OH 44135-3191
(216) 433-4000
www.nasa.gov/centers/glenn/home/index.html

NASA Goddard Space Flight Center (GSFC)
8800 Greenbelt Road
Greenbelt, MD 20771-0001
(301) 286-2000
www.nasa.gov/centers/goddard/home/index.html

NASA Jet Propulsion Laboratory (JPL)
4800 Oak Grove Drive
Pasadena, CA 91109-8099
(818) 354-4321
www.nasa.gov/centers/jpl/home/index.html

NASA Lyndon B. Johnson Space Center (JSC)
Houston, TX 77058-3696
(281) 483-0123
www.nasa.gov/centers/johnson/home/index.html

NASA John F. Kennedy Space Center (KSC)
Kennedy Space Center, FL 32899-0001
(321) 867-5000
www.nasa.gov/centers/kennedy/home/index.html

NASA Langley Research Center (LaRC)
Hampton, VA 23681-2199
(757) 864-1000
www.nasa.gov/centers/langley/home/index.html

NASA George C. Marshall Space Flight Center (MSFC)
Huntsville, AL 35812-0001
(265) 544-2121
www.nasa.gov/centers/marshall/home/index.html

NASA John C. Stennis Space Center (SSC)
Stennis Space Center, MS 39529-6000
(228) 688-2211
www.nasa.gov/centers/stennis/home/index.html

Photo back cover: Backdropped by Earth's horizon and the blackness of space, the International Space Station is featured in this image photographed by an STS-131 crewmember after Space Shuttle *Discovery* began to undock and separate from the Station. (Credit: NASA)

NASA Headquarters
Washington, DC 20546

NP-2010-11-690-HQ

www.nasa.gov